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DRAFT
WATER AND BIOLOGICAL QUALITY OF TWENTY SEVEN MAJOR STREAMS, IN SOUTH AND CENTRAL MANITOBA, CANADA, 1995 THROUGH 1998

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Draft Water and Biological Quality of Twenty Seven Major Streams in South and Central Manitoba, Canada, 1995 through 1998

Summary

In 1995 a program was initiated by Manitoba Conservation (formerly Manitoba Environment) using rapid bioassessment techniques to assess assemblages of macroinvertebrates. The intent of this program is to provide a biological assessment tool to supplement assessments of water quality based on water chemistry alone. This report examines macroinvertebrate data collected in 27 major streams in south and central, Manitoba from 1995 through 1998. Biological condition indices were derived using the combined evaluations of eight assessment indices. Subsequently the biological condition indices were used in conjunction with the Canadian Water Quality Index (CWQI) to assess the environmental health of these streams. The CWQI is based on chemical, physical, and bacteriological analytes in water samples.

Most of the streams assessed for biotic condition ranged from unimpaired to moderately impacted by water quality and other environmental factors. In many cases the condition of the macroinvertebrate communities were consistent with water quality. However, in other situations macroinvertebrate communities appeared to be well adapted and were able thrive in less than optimal water quality conditions. There were also other situations where environmental factors other than water quality appeared to have been detrimental to the health of the macroinvertebrate communities.

Opportunity for Review and Request for Comments

Comments on the conclusions, the bioassessment process used, and the relationship of biotic indices to water quality indices should help to refine the way Manitoba Conservation collects and assesses macroinvertebrate assemblages. Please forward comments by January 31, 2001 to the following:

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DRAFT WATER AND BIOLOGICAL QUALITY OF TWENTY SEVEN MAJOR STREAMS IN SOUTH AND CENTRAL MANITOBA, CANADA, 1995 THROUGH 1998

Introduction

Although macroinvertebrates have been used for bioassessment in the past, there has been a tendency to assess water quality from physical and chemical properties of the water alone. Within the last decade or two there has been renewed interest in the use of biota for stream assessments. There have been changes in the approach and use of bioassessment sampling techniques and analytical protocols that could be used to derive bio-condition indices to supplement physical and chemical water quality indices. For several decades, personnel from the Province of Manitoba have carried out water quality monitoring for chemical and physical parameters in numerous streams and rivers. In 1995 a program was initiated by Manitoba Conservation (formerly Manitoba Environment) using rapid bioassessment techniques to assess assemblages of macroinvertebrates. During the fall of 1995 sampling was carried out at established water quality sites in 25 streams; this was expanded to sites in 27 streams with an extra site sampled on one stream in 1996 and 1997. With the exception of the North Duck River site located near Cowan on the eastern edge of the Duck Mountain forested area, all other sites were located in areas with a greater or lesser degree of agricultural activity. The sites sampled were bounded by the Swan and Woody rivers to the northwest, Pipestone Creek to the southwest, the Roseau River to the southeast and the Brokenhead River to the northeast (Figure 1).

Methods

Bioassessment Sampling Protocols

The sites selected had to be shallow enough so that the streams could be sampled using a kick net and chest waders. Preferable sites were those where it was possible to wade across the entire stream width. However, at some sites, sampling could only be carried out near shore due to excessive depth or strong current offshore. Also, in some cases invertebrate sampling sites were not located immediately at the water quality monitoring site but at the nearest practical location within 1 km of the water quality sampling site.

Equipment used to collect the samples included a kick net with a triangular frame with a bottom width of 0.3048 m (1 ft) and an anchor with a 3.28 m length of rope. The nylon netting used in the kicknet bag had a small aperture size (800 by 900 µm). The anchor and rope were used to tether the kicknet. The person sampling backed upstream, kicking up material from the surface of the substrate into the kicknet, starting at the anchor and backing up to the end of the tether, covering a 1 m^2 area for each sample. As much of the fine material such as muck and silt was washed from the samples by agitating the bottom of the netting in the stream water. Then using clean water, each sample was washed from the net into a white plastic tray. The bottom surface area of the tray was approximately 540 cm^2 or larger with a wall height of at least 5 cm. Five 1 m^2 samples were collected from as many varied habitats as possible. Macroinvertebrates were sorted in the field from the trays without the use of a microscope using forceps, and preserved in 70% ethyl alcohol, with each sample placed in a separately labelled jar.

When each sample was collected, the type of substrate and any presence of submergent and emergent vegetation were recorded. The approximate range in depth, and relative flow at each sample location were also observed. Each sample location was identified on a sketch of the reach of the stream being sampled.

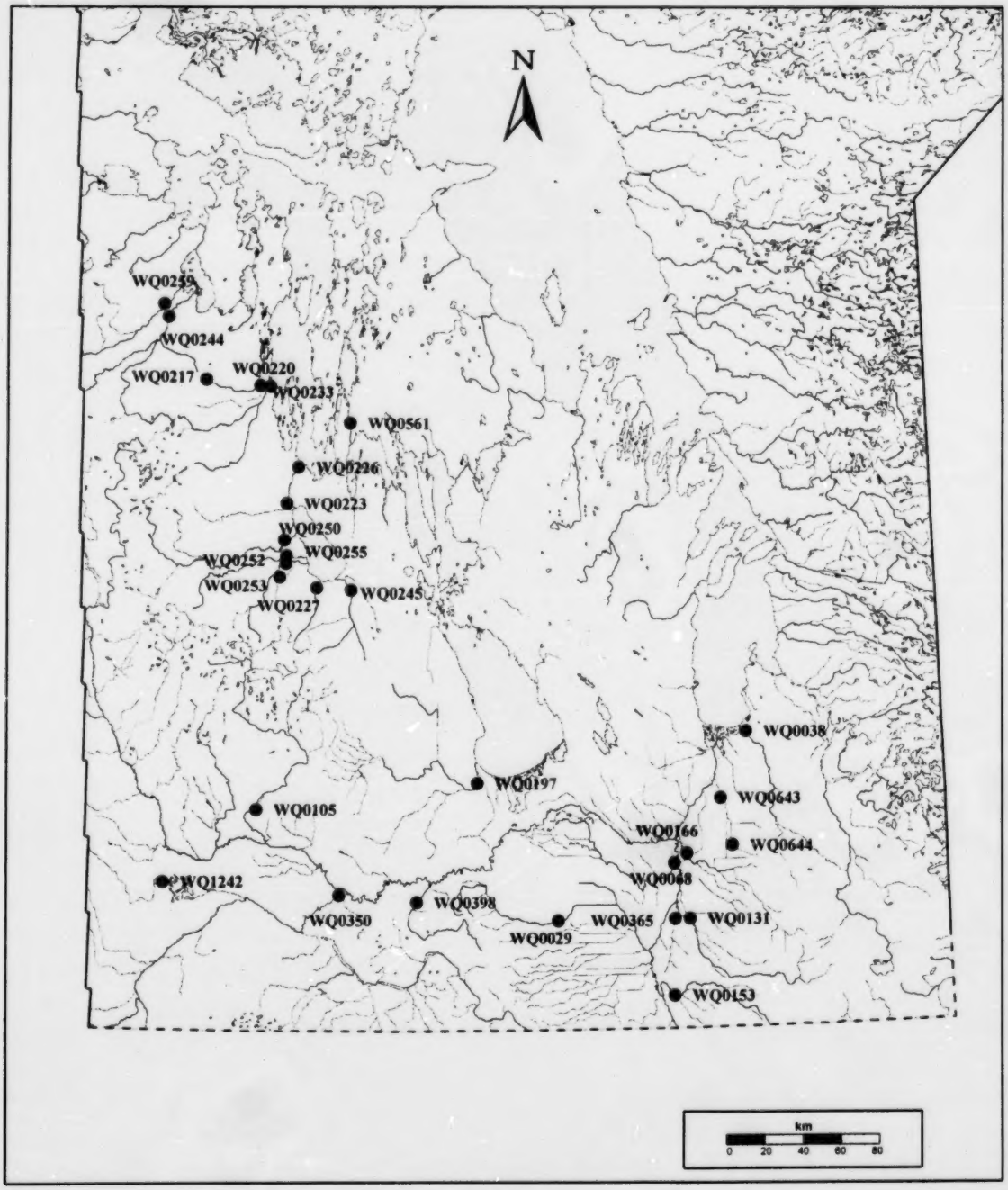

Figure 1. Macroinvertebrate monitoring sites from 1995 through 1998.

Data were also recorded for general site characteristics, date and time of sample collection, water temperature, and approximate surface velocity. The estimate of surface velocity was accomplished using a float timed over a paced distance of 5 or 10 m unless the flow was imperceptible due standing water or wind blowing upstream. Observations were also recorded on shoreline vegetation and other local conditions such as construction activities or the presence of livestock or wildlife in the vicinity of the stream.

Macroinvertebrate Identification

All samples were subsequently submitted to Enviro-Test Laboratories for identification of organisms to genus and species where possible. Each sample was treated separately with respect to identification and enumeration of organisms. Several specimens were submitted for verification of identification to a subcontractor (Ms. L. Ross).

Macroinvertebrate Analyses Protocols

Each set of five samples collected from each site on any one date, was pooled in order to carry out further analyses. At some sites, even when all five samples were pooled, there were less than 100 organisms in total; that is the least number of organisms recommended for data analysis with rapid bioassessment techniques (Plafkin *et al.* 1989). Further analyses were carried out in the bioassessment approach advocated for Rapid Bioassessment Protocol III (Plafkin *et al.* 1989).

Where possible, each taxon was assigned tolerance values and functional feeding groups in order to derive metrics required for bioassessment as described in Plafkin *et al.* (1989). Tolerance values for use with Modified Hilsenhoff Biotic Index or HBI (Hilsenhoff 1987) as well as functional feeding groups were identified using the U.S. Environmental Protection Agency computer program Macroinvertebrate Species List, Version 1 (May, 1994). Additional information on feeding groups was also obtained from Merritt and Cummins (1984). In addition to the metrics required for bioassessment as described in Plafkin *et al.* (1989) each taxon was assigned tolerance quotients required to derive a biotic condition index (BCI) from Winget and Mangum (1979). The BCI compares organism tolerance to physical and chemical instream conditions and is a useful addition to other metrics (Plotnikoff 1994).

There are eight metrics used in this assessment and they are described briefly as follows:

1. Taxa Richness is a count of the total number of taxa and reflects the health of the community through measurement of the variety of taxa (Plafkin *et al.* 1989).
2. Percent Contribution of Dominant Taxon is a reflection of community balance and compares the number of organisms in the dominant taxon to the total number of organisms in the sample (Plafkin *et al.* 1989).
3. The Ephemeroptera, Plecoptera, and Trichoptera (EPT) Index is a count of the number of taxa within this environmentally sensitive group of organisms. The EPT index generally increases with improving water quality (Plafkin *et al.* 1989).
4. The EPT/C Ratio is a ratio of EPT and Chironomidae abundances, which compares the number of organisms within the EPT group to numbers of Chironomidae. Chironomidae or midges are relatively tolerant organisms. This index is also a reflection of community balance (Plafkin *et al.* 1989).
5. The Community Loss Index compares the total number of taxa present in both a reference sample (a) and the sample of comparison (b) relative to taxa in common (c). The Community Loss Index = (a-c)/b (Courtemanch and Davies 1987). The reference sample used in this case was a database mean pooled sample (Plafkin *et al.* 1989).

6. The Modified Hilsenhoff Biotic Index or HBI (Hilsenhoff 1987) is the mean of the sum of tolerance values ranging from 0 to 10, where the values increase as water quality deteriorates (Plafkin *et al.* 1989). The tolerance values used were derived by the New York Department of Environmental Conservation (NYDEC); Hilsenhoff tolerance values. Alternately, US Environmental Protection Agency (EPA) tolerance values were identified using US EPA Macroinvertebrate Species List, Version 1 (May, 1994). However, tolerance values were not available for some species, mainly within the Order Hemiptera.
7. The Biotic Condition Index or BCI (Winget and Mangum 1979) is derived in three stages. First, the average Community Tolerance Quotient (CTQa) is calculated and is the mean of the sum of organism tolerance quotients, which range from 0 to 108, where the values increase as water quality declines. Second is derived the predicted Community Tolerance Quotient (CTQp) using a key that reflects stream gradient, substrate type, total alkalinity, and sulphate. For the purpose of this calculation all stream gradients were estimated to be less than the ratio of 1.2%. Third, the BCI is calculated where BCI = 100(CTQp/CTQa). Since this metric entails both biotic and physical and chemical characteristics of the site, it is particularly site and time specific in nature.
8. The Ratio of Shredders/Total is the ratio of the number of organisms belonging to the shredder functional feeding group to the total number of organisms in the sample. Shredders are sensitive to riparian zone impacts (Plafkin *et al.* 1989).

After the various metrics were calculated for each site and sampling date, the biological condition was then evaluated with scoring criteria as described in the bioassessment flow chart (Figure 2). The treatment of each metric is similar to that utilized by Plafkin *et al.* (1989). The Biotic Condition Index or BCI was an additional metric that was calculated as a modification of the BCI assessment scoring by Winget and Mangum (1979). The derivation of the biological scores (Figure 2) rates the best score at 6 and the poorest score at 0. While some site metrics were treated as stand alone values, others were compared as a ratio of reference conditions (Figure 2). The North Duck River at PTH 10 at Cowan should have had the least impact from anthropogenic activities since it is located on the eastern edge of the Duck Mountain forested area. The best scores from the years 1995 though 1998 at the North Duck River site were used as a reference for comparison with the Taxa Richness, EPT Index, EPT/C Index, and modified Hilsenhoff Biotic Index (HBI). However the Shredders/Total ratio at the North Duck River site were considerably lower than average. Therefore, the Shredders/Total ratio was compared to a reference derived from a mean of all macroinvertebrate data from 1995 though 1998.

The final step in the bioassessment process is described in the bioassessment box of the flow chart (Figure 2). The mean score for each site and year were compared as a ratio to a mean score of the best scores attained at each of the 28 sites during the period of study. The degree of impairment was described as non-impaired, slightly impaired, moderately impaired, or severely impaired.

Water Quality Sampling and Assessment

Water samples were collected at each site from three to 31 times per sampling year. These samples were analyzed for a variety of analytes at EnviroTest Laboratories. Some 24 to 25 analytes from these water samples were used to derive the Canadian water quality index (CWQI) on an annual basis. The CWQI (CCME 2000) assesses non compliance with water quality guidelines and objectives based on three factors: scope (F_1), frequency (F_2), amplitude (F_3) of non compliance at each site and year. The CWQI categories are described as excellent (95-100), good (80-94), fair (60-79), marginal (45-59), and poor (0-44).

Comparisons were made between the degree of impairment indicated by bioassessment and the water quality index categories. In cases where the conclusions drawn

Site Specific Study

Sampling & Analyses

Metric	Biological Condition Scoring Criteria			
	6	4	2	0
1. Taxa Richness[a]	>80%	60-80%	40-60%	<40%
2. % Contribution of Dominant Taxon[b]	<20%	20-30%	30-40%	>40%
3. EPT Index[a]	>90%	80-90%	70-80%	<70%
4. Ratio of EPT and Chironomid Abundances[a]	>75%	50-75%	25-50%	<25%
5. Community Loss Index[c]	<0.5	0.5-1.5	1.5-4.0	>4.0
6. Hilsenhoff Biotic Index (modified)[d]	>85%	70-85%	50-70%	<50%
7. Biotic Condition Index (Winget and Mangum)[e]	>85	80-85	70-80	<70
8. Ratio of Shredders/Total[f,g]	>50%	35-50%	20-35%	<20%

(a) Score is ratio of the study site to the best value obtained at the North Duck River reference site X 100.
(b) Scoring criteria evaluate actual percent contribution, not percent comparability to reference site.
(c) Range of values obtained. A comparison to a data base reference is incorporated in these indices.
(d) Score is ratio of the best value obtained at the North Duck River reference site to the study site X 100.
(e) Range of values obtained. Site specific combination of biotic, physical and chemical data in indices.
(f) Determination of Functional Feeding Group is independent of taxonomic grouping.
(g) Score is ratio of study site to 1995 through 1998 database average X 100.

BIOASSESSMENT

% Comparison to Reference Mean Score[a]	Biological Condition Category	Attributes
>83%	Nonimpaired	This is comparable to the best situation to be expected within an an ecoregion. There is a balanced trophic structure. The community structure (composition and dominance) is optimum for stream size and habitat quality.
54-79%	Slightly Impaired	Community structure is less than expected. Composition (species richness) lower than expected due to absence of some intolerant forms. Percent contribution of tolerant forms increases.
21-50%	Moderately Impaired	Fewer species are present due to absence of most intolerant forms. There is a reduction in the EPT Index.
<17%	Severely Impaired	Few species are present. If high densities of organisms occur, they are dominated by one or two species.

(a) Site mean score is compared to the reference mean score, that is the average of highest scores for any site. Percentage values obtained that are intermediate to the above ranges will require subjective judgement as to the correct placement.Use of habitat assessment and physical and chemical data may be necessary to aid in the decision-making process.

Figure 2. Bioassessment Flow Chart.

from the two assessment techniques were considerably different, then it is possible that factors other than chemical, physical, and bacteriological water quality were affecting the biological condition ratings reflected by invertebrate communities.

Results and Discussion

Macroinvertebrates and Water Quality

A species list for the taxa identified and numbers of each taxon at all sites is shown in Table 1. The Hilsenhoff (1987) or equivalent tolerance values, Winget and Mangum (1979) tolerance quotients, and the functional feeding groups for each taxon are also identified. Appendix 1 summarizes the numbers of organisms collected per taxon per site for each year and shows the percent composition of major macroinvertebrate groups.

The macroinvertebrate metric statistics summarized in Table 2 provides substrate descriptions, estimated stream velocity, and water temperature for each site on each sampling date. This table also provides site descriptions. Appendix 2 shows the mean reference sample for the entire 1995 through 1998 database, which is used for community loss calculations (Courtemanch and Davies 1987). The reference sample in this case was the pooled sample including 83 taxa. Appendix 3 includes the average total alkalinity and sulphate for each site during each sampling year required for the estimation of the Predicted Community Tolerance Quotient or CTQp (Winget and Mangum 1979). The modified Winget and Mangum key for estimating CTQp is also shown in Appendix 3. The stream gradient was always less than 1.2%, and the substrate type was either gravel and rubble or a combination of all substrates including sand and finer substrate (Table 2).

Table 3 summarizes macroinvertebrate bioassessment criteria as described in Figure 2 based on the calculated values used for biological scoring shown in Appendix 4. Table 3 also shows the final outcome of the assessment process as described in Figure 2 with evaluated Biological Condition Categories for each site and year sampled.

The CWQI as well as the macroinvertebrate bioassessment criteria are summarized in Table 4 with an explanation of the index in Appendix 5. CWQI ratings marked with an asterisk are based on less than the recommended five water samples per year (CCME 2000). Differences between the two assessments could be due to a variety of environmental factors. At least one of the parameters used in calculating the CWQI water quality categories, namely phosphorus, may have a positive rather than a negative effect on macroinvertebrate communities to some degree. Phosphorus stimulates algae and macrophyte plant growth that can provide a food source and potential habitat for some macroinvertebrates. On the other hand, excessive plant growth can also lead to algae bloom die-off and plant decay under ice conditions which will lead to oxygen depletion which can result in macroinvertebrate die-off as well.

The numbers of organisms collected at each site varied considerably from year to year and some sites consistently yielded either high numbers of organisms or low numbers of organisms (Table 2). However, the use of multiple metrics as an assessment technique appears to provide a reasonably balanced perspective of biological condition. A sample size of at least 100 organisms per site per sampling date is recommended for accurate estimation of macroinvertebrate community health (Plafkin *et al.* 1989). Precautions should be taken when examining assessments with low numbers of organisms. Various conditions may lead to low numbers of organisms collected and these included sampling difficulty, either due to excessive sampling depth, or difficult footing, in mud or large boulders. However, despite these qualifications the benefit of long term monitoring was evident since variability from year to year could be observed. While most streams assessed usually only varied

Table 1. Species list, total numbers of organisms per taxa, tolerance values and quotients, and functional feeding group designations for macroinvertebrates collected from 1995 thorough 1998.

Phylum or Class	Order or Suborder	Genus and species or Group	Total Number	Hilsenhoff[1] Tolerance	Feeding[2] Group 1	Feeding[2] Group 2	Tolerance Quotients[3]
Arachnoidae	Hydracarina	*Arrenurus sp.*	14				108
Arachnoidae	Hydracarina	*Eylais sp.*	2				108
Arachnoidae	Hydracarina	*Hygrobates sp.*	4				108
Arachnoidae	Hydracarina	*Lebertia sp.*	11				108
Arachnoidae	Hydracarina	*Limnesia sp.*	17				108
Arachnoidae	Hydracarina	*Limnochares sp.*	1				108
Arachnoidae	Hydracarina	*Mideopsis sp.*	3				108
Arachnoidae	Hydracarina	*Piona sp.*	1				108
Arachnoidea	Hydracarina	*Diplodontus sp.*	4				108
Arachnoidea	Hydracarina	*Hydracarina unidentified*	88				108
Arachnoidea	Hydracarina	*Hydrachna sp.*	8				108
Arachnoidea	Hydracarina	*Sperchon sp.*	6				108
Arachnoidea	Hydracarina	*Unionicola sp.*	17				108
Crustacea	Amphipoda	*Crangonyx sp.*	1	6	CG		108
Crustacea	Amphipoda	*Gammarus sp.*	4943	6	SH	CG	108
Crustacea	Amphipoda	*Hyalella azteca*	28274	8	CG		108
Crustacea	Conchostraca	*Caenestheriella sp.*	1				108
Crustacea	Conchostraca	*Cyzicus mexicanus*	1				
Crustacea	Decapoda	Cambaridae unidentified	6	6	SH	CG	108
Crustacea	Decapoda	*Orconectes immunis*	24	6	SH	CG	108
Crustacea	Decapoda	*Orconectes sp.*	80	6	SH	CG	108
Crustacea	Decapoda	*Orconectes virilis*	52	6	SH	CG	108
Insecta	Coleoptera	*Agabus sp.*	3	5	P		72
Insecta	Coleoptera	*Ampumixis sp.*	2	5	SC	CG	108
Insecta	Coleoptera	*Berosus sp.*	1	5	CG	P	72
Insecta	Coleoptera	*Bledius sp.*	2		P		72
Insecta	Coleoptera	*Cleptelmis sp.*	2	5	SC		108
Insecta	Coleoptera	*Colymbetes sp.*	2	5	P		72
Insecta	Coleoptera	*Coptotomus sp.*	1	9	P		72
Insecta	Coleoptera	*Donacia sp.*	4		SH		108
Insecta	Coleoptera	*Dubiraphia sp.*	467	6	SC		108
Insecta	Coleoptera	Elmidae unidentified	1	5	SC	CG	108
Insecta	Coleoptera	*Gyrinus sp.*	6	5	P		108
Insecta	Coleoptera	*Haliplus borealis*	58	5	SH		54
Insecta	Coleoptera	*Haliplus immaculicollis*	8	5	SH		54
Insecta	Coleoptera	*Haliplus sp.*	42	5	SH		54
Insecta	Coleoptera	*Helophorus sp.*	5	5	SH		72
Insecta	Coleoptera	*Hydaticus sp.*	4	5	P		72
Insecta	Coleoptera	*Hydrocanthus sp.*	1	6	P		72
Insecta	Coleoptera	Hydrophilidae unidentified	1	5	SH	P	72
Insecta	Coleoptera	*Hydroporus sp.*	33	5	P	PI	72
Insecta	Coleoptera	*Hygrotus sp.*	1	5	P		72
Insecta	Coleoptera	*Laccophilus biguttatus*	3	5	P		72
Insecta	Coleoptera	*Laccophilus maculosus*	3	5	P		72
Insecta	Coleoptera	*Laccornis sp.*	2		P		72
Insecta	Coleoptera	*Liodessus affinis*	19	5	P		72
Insecta	Coleoptera	*Liodessus sp.*	3	5	P		72
Insecta	Coleoptera	*Optioservus sp.*	141	4	P		108
Insecta	Coleoptera	*Paracymus sp.*	1		CG		72
Insecta	Coleoptera	*Peltodytes edentulus*	26	5	SH		54
Insecta	Coleoptera	*Peltodytes sp.*	22	5	SH		54
Insecta	Coleoptera	*Pyrrhalta sp.*	1		SH		108
Insecta	Coleoptera	*Rhantus sp.*	1	5	PI		72
Insecta	Coleoptera	*Sphaerius sp.*	1	8	FC		108
Insecta	Coleoptera	*Stenelmis sp.*	60	5	SC		108
Insecta	Coleoptera	*Stenus sp.*	1		P		108
Insecta	Diptera Chironomidae	*Ablabesmyia sp.*	174	8	CG	P	108
Insecta	Diptera Chironomidae	Chironomidae unidentified	225		CG		108
Insecta	Diptera Chironomidae	*Chironomus anthracinus*	1	10	SH	CG	108
Insecta	Diptera Chironomidae	*Chironomus plumosus*	110	10	SH	CG	108
Insecta	Diptera Chironomidae	*Chironomus sp.*	1536	10	SH	CG	108
Insecta	Diptera Chironomidae	*Chironomus thummi*	46	10	SH	CG	108
Insecta	Diptera Chironomidae	*Cladopelma sp.*	2	9	CG		108
Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*	104	7	FC		108
Insecta	Diptera Chironomidae	*Clinotanypus sp.*	82	8	P		108
Insecta	Diptera Chironomidae	*Corynoneura sp.*	2	7	CG		108
Insecta	Diptera Chironomidae	*Cricotopus sp.*	231	4	CG		108
Insecta	Diptera Chironomidae	*Cryptochironomus sp.*	72	8	P		108
Insecta	Diptera Chironomidae	*Cryptotendipes sp.*	126	6	CG		108
Insecta	Diptera Chironomidae	*Demicryptochironomus sp.*	13	8	CG		108
Insecta	Diptera Chironomidae	*Derotanypus sp.*	1	9	P		108

Table 1. Species list, total numbers of organisms per taxa, tolerance values and quotients, and functional feeding group designations for macroinvertebrates collected from 1995 thorough 1998 (continued).

Phylum or Class	Order or Suborder	Genus and species or Group	Total Number	Hilsenhoff[1] Tolerance	Feeding[2] Group 1	Feeding[2] Group 2	Tolerance Quotients[3]
Insecta	Diptera Chironomidae	*Dicrotendipes sp.*	511	8	CG		108
Insecta	Diptera Chironomidae	*Einfeldia sp.*	8	9	CG		108
Insecta	Diptera Chironomidae	*Endochironomus sp.*	87	10	SH		108
Insecta	Diptera Chironomidae	*Epoicocladius sp.*	22	4	CG		108
Insecta	Diptera Chironomidae	*Glyptotendipes sp.*	53	10	FC	SH	108
Insecta	Diptera Chironomidae	*Isocladius sp.*	5		P		108
Insecta	Diptera Chironomidae	*Krenosmittia sp.*	2	1	CG		108
Insecta	Diptera Chironomidae	*Labrundinia sp.*	6	7	P		108
Insecta	Diptera Chironomidae	*Lauterborniella sp.*	2		CG		108
Insecta	Diptera Chironomidae	*Micropsectra sp.*	6	7	CG		108
Insecta	Diptera Chironomidae	*Microtendipes sp.*	179	6	FC	CG	108
Insecta	Diptera Chironomidae	*Nanocladius sp.*	2	3	CG		108
Insecta	Diptera Chironomidae	*Natarsia sp.*	6	8	P		108
Insecta	Diptera Chironomidae	*Omisus sp.*	1		CG		108
Insecta	Diptera Chironomidae	*Pagastiella sp.*	2		CG		108
Insecta	Diptera Chironomidae	*Parachironomus sp.*	13	10	CG	P	108
Insecta	Diptera Chironomidae	*Paracladopelma sp.*	6	7	CG		108
Insecta	Diptera Chironomidae	*Paracryptochironomus sp.*	1		CG		108
Insecta	Diptera Chironomidae	*Paralauterborniella sp.*	4	8	CG		108
Insecta	Diptera Chironomidae	*Paramerina sp.*	30	3	CG		108
Insecta	Diptera Chironomidae	*Parametriocnemus sp.*	1	5	CG		108
Insecta	Diptera Chironomidae	*Paratanytarsus sp.*	115	7	CG		108
Insecta	Diptera Chironomidae	*Paratendipes sp.*	185	8	CG		108
Insecta	Diptera Chironomidae	*Phaenopsectra sp.*	747	7	SC		108
Insecta	Diptera Chironomidae	*Polypedilum sp.*	227	6	SH		108
Insecta	Diptera Chironomidae	*Potthastia sp.*	1	2	CG		108
Insecta	Diptera Chironomidae	*Procladius sp.*	633	9	P		108
Insecta	Diptera Chironomidae	*Psectrocladius sp.*	26	8	P		108
Insecta	Diptera Chironomidae	*Pseudochironomus sp.*	6	5	CG		108
Insecta	Diptera Chironomidae	*Rheotanytarsus sp.*	209	6	FC		108
Insecta	Diptera Chironomidae	*Robackia demeijerei*	12	4	CG		108
Insecta	Diptera Chironomidae	*Robackia sp.*	14	4	CG		108
Insecta	Diptera Chironomidae	*Stempellinella sp.*	1	5	CG		108
Insecta	Diptera Chironomidae	*Stenochironomus sp.*	112	5	SH	CG	108
Insecta	Diptera Chironomidae	*Stictochironomus sp.*	164	9	CG		108
Insecta	Diptera Chironomidae	Tanypodinae unidentified	4		P		108
Insecta	Diptera Chironomidae	*Tanypus sp.*	3	10	P		108
Insecta	Diptera Chironomidae	*Tanytarsus sp.*	326	6	FC		108
Insecta	Diptera Chironomidae	*Thienemanniella sp.*	10	2	CG		108
Insecta	Diptera Chironomidae	*Thienemannimyia sp.*	1	6	P		108
Insecta	Diptera Chironomidae	*Tribelos sp.*	12	6	CG		108
Insecta	Diptera Miscellaneous	*Alluaudomya sp.*	1	6	P		108
Insecta	Diptera Miscellaneous	*Atherix sp.*	95	2	P		24
Insecta	Diptera Miscellaneous	Chaobonnae unidentified	1	8	P		108
Insecta	Diptera Miscellaneous	*Chaoborus sp.*	18	8	P		108
Insecta	Diptera Miscellaneous	*Chrysops sp.*	45	7	PI	CG	108
Insecta	Diptera Miscellaneous	Diptera Miscellaneous unidentifie	75				108
Insecta	Diptera Miscellaneous	*Dixa sp.*	1	1	CG	FC	108
Insecta	Diptera Miscellaneous	*Eriocera sp.*	58	7	CG		72
Insecta	Diptera Miscellaneous	*Hemerodromia sp.*	22	6	P		108
Insecta	Diptera Miscellaneous	*Hexatoma sp.*	60	2	P		36
Insecta	Diptera Miscellaneous	*Limnophora sp.*	6	3	P		108
Insecta	Diptera Miscellaneous	*Lispocephala sp.*	1	6	P		108
Insecta	Diptera Miscellaneous	*Metacnephia sp.*	1	6	FC		108
Insecta	Diptera Miscellaneous	*Ormosia sp.*	2		CG		72
Insecta	Diptera Miscellaneous	*Palpomyia sp.*	293	6	P		108
Insecta	Diptera Miscellaneous	*Pilaria sp.*	4	7	P		72
Insecta	Diptera Miscellaneous	*Prosimulium sp.*	2	2	FC		108
Insecta	Diptera Miscellaneous	Simuliidae unidentified	7	6	FC		108
Insecta	Diptera Miscellaneous	*Simulium sp.*	174	6	FC		108
Insecta	Diptera Miscellaneous	*Tabanus sp.*	4	7	PI	P	108
Insecta	Diptera Miscellaneous	*Tipula sp.*	20	6	SH		36
Insecta	Ephemeroptera	Baetidae unidentified	17	6	CG	SC	72
Insecta	Ephemeroptera	*Baetis sp.*	1119	6	CG		72
Insecta	Ephemeroptera	*Baetisca lacustris*	9	5	CG		72
Insecta	Ephemeroptera	*Baetisca sp.*	224	4	CG		72
Insecta	Ephemeroptera	*Caenis sp.*	5180	7	CG		72
Insecta	Ephemeroptera	*Callibaetis sp.*	382	9	CG		72
Insecta	Ephemeroptera	*Centroptilum sp.*	131	2	CG		36
Insecta	Ephemeroptera	*Cinygmula sp.*	4	3	CG		21
Insecta	Ephemeroptera	*Cloeon sp.*	22	4	CG		72

Table 1. Species list, total numbers of organisms per taxa, tolerance values and quotients, and functional feeding group designations for macroinvertebrates collected from 1995 thorough 1998 (continued).

Phylum or Class	Order or Suborder	Genus and species or Group	Total Number	Hilsenhoff[1] Tolerance	Feeding[2] Group 1	Feeding[2] Group 2	Tolerance Quotients[3]
Insecta	Ephemeroptera	*Ephemera simulans*	78	1	CG		36
Insecta	Ephemeroptera	*Ephemera sp.*	208	2	CG		36
Insecta	Ephemeroptera	Ephemeroptera unidentified	28		CG		72
Insecta	Ephemeroptera	*Heptagenia sp.*	7	4	SC		48
Insecta	Ephemeroptera	*Heterocloeon sp.*	1	4	SC		72
Insecta	Ephemeroptera	*Hexagenia limbata*	468	5	CG		36
Insecta	Ephemeroptera	*Hexagenia recurvata*	1	6	CG		36
Insecta	Ephemeroptera	*Hexagenia rigida*	15	6	CG		36
Insecta	Ephemeroptera	*Hexagenia sp.*	749	6	CG		36
Insecta	Ephemeroptera	*Isonychia sp.*	1	2	FC	CG	48
Insecta	Ephemeroptera	*Leptophlebia sp.*	811	4	CG	SH	24
Insecta	Ephemeroptera	*Leucrocuta sp.*	24	1	SC		72
Insecta	Ephemeroptera	*Paraleptophlebia sp.*	468	1	CG		24
Insecta	Ephemeroptera	*Potamanthus sp.*	6	4	CG		72
Insecta	Ephemeroptera	*Pseudocloeon sp.*	164	4	SC	CG	72
Insecta	Ephemeroptera	*Siphlopecton interlineatum*	1	2			72
Insecta	Ephemeroptera	*Siphloplecton sp.*	13	2	CG		72
Insecta	Ephemeroptera	*Stenacron sp.*	1310	4	SC		48
Insecta	Ephemeroptera	*Stenonema sp.*	547	3	SC		48
Insecta	Ephemeroptera	*Tricorythodes sp.*	38	4	CG		108
Insecta	Hemiptera	*Belostoma flumineum*	1		P		72
Insecta	Hemiptera	*Belostoma sp.*	3		P		72
Insecta	Hemiptera	*Callicorixa sp.*	121		P		108
Insecta	Hemiptera	*Cenocorixa sp.*	7		P		108
Insecta	Hemiptera	Corixidae unidentified	3140		PI	P	108
Insecta	Hemiptera	*Dasycorixa hybrida*	1		P	PI	108
Insecta	Hemiptera	Hemiptera unidentified	4		P	PI	108
Insecta	Hemiptera	*Hesperocorixa alternata*	3	5	P	PI	108
Insecta	Hemiptera	*Hesperocorixa sp.*	294	5	P	PI	108
Insecta	Hemiptera	*Hesperocorixa vulgaris*	1	5	P	PI	108
Insecta	Hemiptera	*Macrovelia sp.*	1		P	PI	72
Insecta	Hemiptera	*Mesovelia sp.*	2		P		72
Insecta	Hemiptera	*Metrobates hesperius*	2		P		72
Insecta	Hemiptera	*Notonecta kirbyi*	2		P		108
Insecta	Hemiptera	*Notonecta sp.*	3		P		108
Insecta	Hemiptera	*Palmacorixa buena*	1		P		108
Insecta	Hemiptera	*Palmacorixa buenoi*	5		P		108
Insecta	Hemiptera	*Palmacorixa gillettei*	7		P		108
Insecta	Hemiptera	*Palmacorixa sp.*	33		P		108
Insecta	Hemiptera	*Ptea striola*	172		P		108
Insecta	Hemiptera	*Renatra fusca*	11		P		72
Insecta	Hemiptera	*Rheumatobates sp.*	1		P		72
Insecta	Hemiptera	*Saldidae unidentified*	1		P		72
Insecta	Hemiptera	*Saldula sp.*	3		P		72
Insecta	Hemiptera	*Sigara decoratella*	9		PI		108
Insecta	Hemiptera	*Sigara fallenoidea*	3		PI		108
Insecta	Hemiptera	*Sigara lineata*	609		PI		108
Insecta	Hemiptera	*Sigara sp.*	752		PI		108
Insecta	Hemiptera	*Sigara trilineata*	53		PI		108
Insecta	Hemiptera	*Trepobates sp.*	1		P		72
Insecta	Hemiptera	*Trichocorixa borealis*	83		P		108
Insecta	Hemiptera	*Trichocorixa sp.*	4		P		108
Insecta	Hemiptera	*Trichocorixa verticalis interiores*	2		P		108
Insecta	Hemptera	*Trichocorixa naias*	18		P		108
Insecta	Lepidoptera	*Acentria sp.*	3		SH		72
Insecta	Lepidoptera	*Archanara sp.*	1		SH		72
Insecta	Megaloptera	*Chauliodes sp.*	1	6	P		108
Insecta	Megaloptera	*Sialis sp.*	261	4	P		72
Insecta	Neuroptera	*Climacia sp.*	2	5	P		72
Insecta	Odonata	*Aeschna sp.*	6	5	P		72
Insecta	Odonata	*Anax sp.*	2	5	P		72
Insecta	Odonata	*Basiaeschna sp.*	2	2	P		72
Insecta	Odonata	*Boyeria sp.*	3	2	P		72
Insecta	Odonata	*Calopteryx sp.*	35	6	P		108
Insecta	Odonata	*Dromogomphus sp.*	125	5	P		108
Insecta	Odonata	*Enallagma sp.*	609	8	P		72
Insecta	Odonata	*Gomphus sp.*	3	5	P		108
Insecta	Odonata	*Ischnura sp.*	17	6	P		72
Insecta	Odonata	*Leucorrhinia sp.*	1	9	P		72
Insecta	Odonata	Odonata unidentified	1		P		108
Insecta	Odonata	*Ophiogomphus sp.*	30	1	P		108

Table 1. Species list, total numbers of organisms per taxa, tolerance values and quotients, and functional feeding group designations for macroinvertebrates collected from 1995 thorough 1998 (continued).

Phylum or Class	Order or Suborder	Genus and species or Group	Total Number	Hilsenhoff[1] Tolerance	Feeding[2] Group 1	Feeding[2] Group 2	Tolerance Quotients[3]
Insecta	Odonata	*Stylurus sp.*	2	5	P		108
Insecta	Odonata	*Tetragoneuria sp.*	2	5	P		72
Insecta	Plecoptera	*Acroneuria sp.*	5	0	P		6
Insecta	Plecoptera	*Eccoptura sp.*	8	1	P		24
Insecta	Plecoptera	*Isoperla sp.*	34	2	P		48
Insecta	Plecoptera	*Pteronarcys sp.*	4	0	SH		24
Insecta	Plecoptera	*Taeniopteryx sp.*	5	2	SH		48
Insecta	Plecoptera	Plecoptera unidentified	8	2	P		48
Insecta	Trichoptera	*Agraylea sp.*	2	8	PI	CG	108
Insecta	Trichoptera	*Banksiola sp.*	1	2	SH		72
Insecta	Trichoptera	*Brachycentrus sp.*	18	1	FC		24
Insecta	Trichoptera	*Ceraclea sp.*	3	3	CG		54
Insecta	Trichoptera	*Ceratopsyche sp.*	2	5	FC		108
Insecta	Trichoptera	*Cheumatopsyche sp.*	525	5	FC		108
Insecta	Trichoptera	*Fabria sp.*	1	4	SH		72
Insecta	Trichoptera	*Hydatophylax sp.*	17	2	SH		108
Insecta	Trichoptera	*Hydropsyche sp.*	342	4	FC		108
Insecta	Trichoptera	*Hydroptila sp.*	27	6	PI	CG	108
Insecta	Trichoptera	Hydroptilidae unidentified	12	4	PI		108
Insecta	Trichoptera	*Lepidostoma sp.*	5	1	SH		18
Insecta	Trichoptera	*Mystacides sp.*	5	4	CG		54
Insecta	Trichoptera	*Nectopsyche sp.*	177	3	SH		54
Insecta	Trichoptera	*Neureclipsis sp.*	212	7	FC		72
Insecta	Trichoptera	*Nyctiophylax sp.*	3	5	FC		108
Insecta	Trichoptera	*Ochrotrichia sp.*	2	4	PI	SC	108
Insecta	Trichoptera	*Oecetis sp.*	39	6	P		54
Insecta	Trichoptera	*Phryganea sp.*	37	8	SH		72
Insecta	Trichoptera	*Polycentropus sp.*	54	6	FC		72
Insecta	Trichoptera	*Psychomyia sp.*	2	2	CG		108
Insecta	Trichoptera	*Philostomis sp.*	47	5	SH		72
Insecta	Trichoptera	*Pycnopsyche sp.*	1	4	SH		72
Insecta	Trichoptera	*Triaenodes sp.*	7	6	SH		54
Insecta	Trichoptera	Trichoptera unidentified	4				72
Bryozoa	Bryozoa	*Bryozoa*	1				108
Coelenterata	Coelenterata	*Hydra sp.*	10	5	P		108
Nematoda	Nematoda	Nematoda unidentified	4				108
Nematomorpha	Nematomorpha	Nematomorpha unidentified	3				108
Annelida	Branchiobdellida	*Branchiobdella sp.*	45	6	CG		108
Annelida	Branchiobdellida	*Cambarincola sp.*	209	6	CG		108
Annelida	Hirudinea	*Actinobdella sp.*	3	8	P		108
Annelida	Hirudinea	*Batracobdella picta*	1	8	P		108
Annelida	Hirudinea	*Batracobdella sp.*	2	8	P		108
Annelida	Hirudinea	*Dina sp.*	56	8	P		108
Annelida	Hirudinea	*Erpobdella punctata*	6	8	P		108
Annelida	Hirudinea	*Glossiphonia complanata*	12	8	P		108
Annelida	Hirudinea	*Helobdella sp.*	5	6	P		108
Annelida	Hirudinea	*Helobdella stagnalis*	27	6	P		108
Annelida	Hirudinea	*Mollobdella grandis*	1	6	P		108
Annelida	Hirudinea	*Nephelopsis obscura*	2	8	P		108
Annelida	Hirudinea	*Placobdella montifera*	6	6	P		108
Annelida	Hirudinea	*Placobdella papillifera*	3	6	P		108
Annelida	Hirudinea	*Placobdella sp.*	3	6	P		108
Annelida	Oligochaeta	*Aeolosoma sp.*	61	8	FC		108
Annelida	Oligochaeta	*Dero sp.*	66	10	CG		108
Annelida	Oligochaeta	*Limnodrilus cacustis*	1	10	CG		108
Annelida	Oligochaeta	*Limnodrilus sp.*	109	10	CG		108
Annelida	Oligochaeta	*Limnodrilus udekemianus*	2	10	CG		108
Annelida	Oligochaeta	*Lumbriculus inconstans*	1	8	CG		108
Annelida	Oligochaeta	*Lumbriculus sp.*	6	8	CG		108
Annelida	Oligochaeta	Naididae unidentified	1		CG		108
Annelida	Oligochaeta	*Naidium sp.*	10		CG		108
Annelida	Oligochaeta	*Nais sp.*	87	8	CG		108
Annelida	Oligochaeta	Oligochaeta unidentified	5				108
Annelida	Oligochaeta	*Ophidonais serpentina*	6	6	CG		108
Annelida	Oligochaeta	*Paranais sp.*	71		CG		108
Annelida	Oligochaeta	*Plesiopora unidentified*	15		CG		108
Annelida	Oligochaeta	*Pristina sp.*	11	8	CG		108
Annelida	Oligochaeta	*Prosopora unidentified*	4		CG		108
Annelida	Oligochaeta	*Stylaria lacustris*	17	8	CG		108
Annelida	Oligochaeta	*Tubifex sp.*	110	10	CG		108
Annelida	Oligochaeta	Tubificidae unidentified	1	10	CG		108

Table 1. Species list, total numbers of organisms per taxa, tolerance values and quotients, and functional feeding group designations for macroinvertebrates collected from 1995 thorough 1998 (continued).

Phylum or Class	Order or Suborder	Genus and species or Group	Total Number	Hilsenhoff[1] Tolerance	Feeding[2] Group 1	Feeding[2] Group 2	Tolerance Quotients[3]
Gastropoda	Ctenobranchiata	*Amnicola limosa*	2325		SC		108
Gastropoda	Ctenobranchiata	*Amnicola sp.*	6	8	SC		108
Gastropoda	Ctenobranchiata	*Amnicola walkeri*	2	8	SC		108
Gastropoda	Ctenobranchiata	*Cincinnatia cincinnatiensis*	209	8	SC		108
Gastropoda	Ctenobranchiata	*Marstonia decepta*	47	8	SC		108
Gastropoda	Ctenobranchiata	*Probythinella lacustris*	1	8	SC		108
Gastropoda	Ctenobranchiata	*Valvata sincera*	11	8	SC		108
Gastropoda	Ctenobranchiata	*Valvata sp.*	1	8	SC		108
Gastropoda	Ctenobranchiata	*Valvata tricarinata*	103	8	SC		108
Gastropoda	Pulmonata	*Aplexa hypnorum*	1	7	SC		108
Gastropoda	Pulmonata	*Armiger crista*	2	6	SC		108
Gastropoda	Pulmonata	*Ferrissia rivularis*	236	6	SC		108
Gastropoda	Pulmonata	*Ferrissia sp.*	226	6	SC		108
Gastropoda	Pulmonata	*Gyraulus sp.*	188	6	SC		108
Gastropoda	Pulmonata	*Helisoma anceps*	34	6	SC		108
Gastropoda	Pulmonata	*Helisoma campanulatum*	4	6	SC		108
Gastropoda	Pulmonata	*Helisoma sp.*	2	6	SC		108
Gastropoda	Pulmonata	*Lymnaea sp.*	8	6	SC		108
Gastropoda	Pulmonata	*Lymnaea stagnalis*	1	6	SC		108
Gastropoda	Pulmonata	*Physa sp.*	743	8	SC	CG	108
Gastropoda	Pulmonata	*Planorbula sp.*	4	7	SC		108
Gastropoda	Pulmonata	*Promenetus exacuous*	1	6	SC		108
Pelecypoda	Sphaeriidae	Pisidium sp.	344	8	FC		108
Pelecypoda	Sphaeriidae	Sphaerium simile	122	8	FC		108
Pelecypoda	Sphaeriidae	Sphaerium sp.	1633	8	FC		108
Pelecypoda	Unionidae	Anodonta grandis	525	3	FC		108
Pelecypoda	Unionidae	Anodontoides ferussacianus	1		FC		108
Pelecypoda	Unionidae	Anodontoides sp.	1		FC		108
Pelecypoda	Unionidae	Lampsilis ovata	1	1	FC		108
Pelecypoda	Unionidae	Lasmigona complanata	2		FC		108
Pelecypoda	Unionidae	Strophitus undulatus	1	4	FC		108
Pelecypoda	Unionidae	Unionidae unidentified	10		FC		108
Porifera	Porifera	Porifera unidentified	1				108

1. Tolerance values for use with HBI or Modified Hilsenhoff Biotic Index (Hilsenhoff, 1987) are based on tolerance values of individuals within a species using NYDEC or Hilsenhoff tolerance values where possible or alternately EPA values were identified using US EPA Macroinvertebrate Species List, Version 1 (May, 1994). Although a number of species, mainly within the Order Hemiptera, were not assigned tolerance values, Lenat values were not used as they are based on a different range.

2. Functional Feeding Groups were identified using US EPA Macroinvertebrate Species List, Version 1 (May, 1994) with additional information from Merritt and Cummins (1984). Feeding groups include: collector gatherers (CG), filter collectors (FC), predators (P), piercers (P), scrapers (SC), and shredders (SH).

3. Tolerance quotients of individuals within a species required for calculation of BCI or Biotic Condition Index were identified from Winget and Magum (1979).

Table 2. Summary of macroinvertebrate statistics, substrate, stream velocity at surface, and water temperature, 1995 through 1998.

Stream	Location	Site	Date	Total Organisms (N)	Dominant Taxon (n)	Dominant Taxon (%)	Organisms/ m^2	Taxa Richness	EPT (n)	EPT Index	C (n)	EPT/C	Community Loss[1]	Available HBI Organism Tolerences[2]	HBI[2]	Tolerance[3] CTQa Invert.
Boyne R.	Carman	WQ0029	1995-09-20	149	42	28%	30	23	8	1	30	27%	2.9	133	7.46	105
Boyne R.	Carman	WQ0029	1996-09-09	335	81	24%	67	30	19	2	129	15%	1.9	330	8.04	105
Boyne R.	Carman	WQ0029	1997-08-22	434	97	22%	87	42	43	5	76	57%	1.2	418	6.62	100
Boyne R.	Carman	WQ0029	1998-09-04	101	16	16%	20	26	14	2	40	35%	2.3	90	7.23	95
Brokenhead R.	PTH 59	WQ0038	1995-09-26	445	298	67%	89	27	53	6	28	189%	2.2	433	7.70	102
Brokenhead R.	PTH 59	WQ0038	1996-09-16	552	356	64%	110	29	90	5	16	563%	2.2	546	7.42	100
Brokenhead R.	PTH 59	WQ0038	1997-08-20	558	399	72%	112	40	78	7	13	600%	1.4	550	7.68	102
Brokenhead R.	PTH 59	WQ0038	1998-09-03	354	154	44%	71	41	197	8	14	1407%	1.4	348	6.74	83
La Salle R.	St. Norbert	WQ0068	1995-09-19	48	16	33%	10	18	7	2	23	30%	4.0	47	7.77	99
La Salle R.	St. Norbert	WQ0068	1996-09-17	79	29	37%	16	16	8	2	3	267%	4.3	51	7.49	103
La Salle R.	St. Norbert	WQ0068	1997-08-19	225	99	44%	45	19	6	2	162	4%	4.0	215	8.36	102
La Salle R.	St. Norbert	WQ0068	1998-08-19	44	26	59%	9	10	1	1	27	4%	7.7	27	9.70	106
L. Saskatchewan R.	PTH 25	WQ0105	1995-09-21	4673	3897	83%	935	39	240	12	466	52%	1.3	4662	7.85	106
L. Saskatchewan R.	PTH 25	WQ0105	1996-09-18	6968	5491	79%	1398	66	926	16	70	1326%	0.7	6942	7.78	103
L. Saskatchewan R.	PTH 25	WQ0105	1997-09-09	3825	3476	91%	765	41	221	7	87	254%	1.5	3794	7.86	106
L. Saskatchewan R.	PTH 25	WQ0105	1998-09-16	3121	2047	66%	624	43	743	11	110	675%	1.3	3079	7.92	99
Rat R.	PR 303	WQ0131	1995-09-20	663	235	35%	133	41	415	12	32	1297%	1.4	628	5.20	78
Rat R.	PR 303	WQ0131	1996-09-09	474	104	22%	95	31	407	7	36	1131%	1.9	470	5.37	88
Rat R.	PR 303	WQ0131	1997-09-10	997	521	53%	195	32	351	9	32	1097%	1.8	954	3.80	92
Rat R.	PR 303	WQ0131	1998-08-20	372	88	24%	74	36	123	10	20	615%	1.5	202	6.16	93
Roseau R. Dam	W of PR200	WQ0153	1995-09-20	131	45	34%	26	19	61	9	6	1017%	3.7	74	3.96	81
Roseau R. Dam	W of PR200	WQ0153	1996-09-09	54	22	41%	11	12	50	9	1	5000%	6.3	54	3.48	57
Roseau R. Dam	W of PR200	WQ0153	1997-08-22	94	23	24%	19	24	69	11	7	986%	2.6	92	3.98	66
Roseau R. Dam	W of PR200	WQ0153	1998-09-04	92	16	17%	18	26	55	11	24	393%	2.3	86	5.64	79
Seine R.	PTH 100	WQ0166	1995-09-19	439	120	27%	74	36	23	8	16	144%	1.8	414	7.01	102
Seine R.	PTH 100	WQ0166	1996-09-17	477	233	49%	95	31	21	3	349	6%	1.9	472	8.49	105
Seine R.	PTH 100	WQ0166	1997-08-19	351	118	34%	70	24	6	2	55	11%	2.6	347	6.87	97
Seine R.	PTH 100	WQ0166	1998-08-18	2016	1580	78%	403	32	22	4	27	81%	1.9	2000	7.83	107
Whitemud R.	Westbourne	WQ0197	1995-09-21	358	143	40%	72	36	241	12	85	284%	1.6	356	5.46	63
Whitemud R.	Westbourne	WQ0197	1996-09-19	593	212	36%	119	30	333	11	90	370%	2.1	566	5.81	84
Whitemud R.	Westbourne	WQ0197	1997-09-09	758	165	22%	152	56	451	16	50	903%	0.8	718	5.43	79
Whitemud R.	Westbourne	WQ0197	1998-09-16	330	38	12%	66	37	87	8	59	147%	1.5	329	7.18	95
N. Duck R.	PTH 10	WQ0217	1995-09-26	794	532	67%	159	29	60	9	5	1200%	2.2	109	4.52	103
N. Duck R.	PTH 10	WQ0217	1996-08-27	63	41	65%	13	15	13	6	4	325%	4.7	21	5.10	96
N. Duck R.	PTH 10	WQ0217	1997-08-26	227	124	55%	45	29	70	10	15	467%	2.1	98	4.46	92
N. Duck R.	PTH 10	WQ0217	1998-09-22	638	528	83%	128	24	25	9	30	83%	2.6	62	6.95	106
Sclater R.	PTH 20	WQ0220	1995-09-26	142	46	32%	28	25	2	2	30	7%	2.6	133	7.70	95
Sclater R.	PTH 20	WQ0220	1996-08-27	436	126	29%	87	32	243	10	36	675%	1.9	433	6.90	87
Sclater R.	PTH 20	WQ0220	1997-08-26	235	56	24%	47	37	126	8	19	663%	1.5	221	7.04	84
Sclater R.	PTH 20	WQ0220	1998-09-22	144	62	43%	29	16	0	0	12	0%	4.5	129	7.74	92
Fishing R.	PTH 20	WQ0223	1995-09-25	392	121	31%	78	31	70	5	99	71%	1.9	343	7.76	101
Fishing R.	PTH 20	WQ0223	1996-08-26	42	10	24%	8	18	10	4	2	500%	4.1	39	7.23	99
Fishing R.	PTH 20	WQ0223	1997-08-25	82	19	23%	16	20	52	9	11	473%	3.4	79	5.67	78
Fishing R.	PTH 20	WQ0223	1998-09-24	192	69	36%	38	17	149	10	13	4967%	4.1	182	4.49	58

Table 2. Summary of macroinvertebrate statistics, substrate, stream velocity at surface, and water temperature, 1995 through 1998 (continued).

Stream	Location	Site	Date	Total Organisms (N)	Dominant Taxon (n)	Dominant Taxon (%)	Organisms/ m^2	Taxa Richness	EPT (n)	EPT Index	C (n)	EPT/C	Community Loss[1]	Available HBI Organism Tolerances[2]	HBI[2]	Tolerance[3] CTQa Invert.
Mossy R.	PR 364	WQ0226	1995-09-25	371	143	39%	74	31	165	10	11	1500%	1.8	368	6.10	84
Mossy R.*	PR 364	WQ0226	1996-08-26	341	75	22%	68	35	85	8	138	62%	1.7	336	6.82	91
Mossy R.	PR 364	WQ0226	1997-08-25	291	75	26%	58	34	119	7	35	340%	1.8	281	6.41	81
Mossy R.	PR 364	WQ0226	1998-09-23	254	59	23%	51	34	121	11	27	465%	1.8	206	5.87	77
Ochre R.	PTH 20	WQ0227	1995-09-25	64	31	48%	13	17	53	9	4	1325%	4.2	61	6.05	69
Ochre R.	PTH 20	WQ0227	1996-08-26	99	50	51%	20	21	79	11	8	988%	3.4	96	3.36	59
Ochre R.	PTH 20	WQ0227	1997-08-27	268	124	46%	54	28	69	7	24	173%	2.1	137	5.61	94
Ochre R.	PTH 20	WQ0227	1998-09-21	178	46	26%	36	31	96	17	29	960%	1.9	176	5.38	80
Pine R.	PTH 20	WQ0233	1995-09-26	292	56	19%	58	39	43	12	44	98%	1.5	259	7.36	96
Pine R.	PTH 20	WQ0233	1996-08-27	178	37	21%	36	28	19	4	95	20%	2.3	169	7.62	96
Pine R.	PTH 20	WQ0233	1997-08-26	331	64	21%	62	42	69	4	62	111%	1.3	300	7.51	95
Pine R.	PTH 20	WQ0233	1998-09-23	718	130	18%	144	51	115	6	198	58%	0.9	634	7.73	94
Swan R.	PR 268	WQ0244	1995-09-26	64	32	50%	13	10	49	5	0	infinate	7.5	64	4.38	78
Swan R.	PR 268	WQ0244	1996-08-27	41	9	22%	8	14	18	6	4	450%	5.0	38	5.87	76
Swan R.	PR 268	WQ0244	1997-08-26	152	26	18%	30	23	107	13	31	345%	2.7	151	4.08	69
Swan R.	PR 268	WQ0244	1998-09-22	128	41	32%	26	22	87	9	24	363%	3.0	121	4.98	68
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1995-09-25	257	131	51%	51	29	47	5	18	261%	2.1	223	7.19	98
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1996-08-26	626	491	78%	125	28	20	9	12	167%	2.2	546	7.75	106
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1997-08-27	648	413	64%	130	28	44	4	60	73%	2.0	580	7.78	105
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1998-09-21	549	279	51%	110	35	38	7	13	292%	1.5	122	6.80	104
Valley R.	PTH 20	WQ0250	1995-09-25	530	102	19%	106	33	179	11	89	201%	1.8	497	5.18	87
Valley R.	PTH 20	WQ0250	1996-08-26	65	21	32%	13	20	18	6	14	129%	3.5	57	7.17	95
Valley R.	PTH 20	WQ0250	1997-08-25	100	18	18%	20	28	64	12	17	376%	2.2	94	5.06	76
Valley R.	PTH 20	WQ0250	1998-09-21	73	31	42%	15	13	61	6	7	871%	5.6	71	3.65	43
Vermilion R.	PTH 20	WQ0252	1995-09-25	188	65	35%	38	19	153	7	4	3825%	3.5	185	4.44	48
Vermilion R.	PTH 20	WQ0252	1996-08-26	224	109	49%	45	25	19	7	60	32%	2.5	208	7.76	102
Vermilion R.	PTH 20	WQ0252	1997-08-25	229	114	50%	46	25	149	9	11	1355%	2.6	207	6.51	80
Vermilion R.	PTH 20	WQ0252	1998-09-24	126	46	37%	25	27	30	9	6	500%	2.2	124	6.74	92
Edwards Cr.	PTH 5/10	WQ0253	1995-09-25	955	191	20%	191	42	503	14	323	156%	1.3	923	5.78	93
Edwards Cr.	PTH 5/10	WQ0253	1996-08-26	871	360	41%	174	49	235	16	562	42%	1.0	827	6.72	95
Edwards Cr.	PTH 5/10	WQ0253	1997-08-27	391	150	38%	78	40	297	13	31	958%	1.3	383	5.26	77
Edwards Cr.	PTH 5/10	WQ0253	1998-09-24	66	26	39%	13	13	48	8	2	39%	5.5	66	4.55	61
Wilson R.	PTH 20	WQ0255	1995-09-25	299	130	43%	60	18	184	5	5	3680%	3.9	198	4.73	63
Wilson R.	PTH 20	WQ0255	1996-08-26	126	49	39%	25	26	76	7	31	245%	2.4	125	6.55	81
Wilson R.	PTH 20	WQ0255	1997-08-25	341	186	55%	68	20	30	6	61	49%	3.3	148	6.36	103
Wilson R.	PTH 20	WQ0255	1998-09-21	115	59	51%	23	18	91	10	1	9100%	3.7	98	4.85	63
Woody R.	PR 268	WQ0259	1995-09-26	93	19	20%	19	26	21	9	9	233%	2.4	86	6.23	93
Woody R.	PR 268	WQ0259	1996-08-27	42	17	40%	8	10	2	1	29	7%	7.5	41	6.98	101
Woody R.	PR 268	WQ0259	1997-08-26	1033	642	60%	207	45	792	15	40	747%	1.1	1009	5.58	54
Woody R.	PR 268	WQ0259	1998-09-22	795	386	49%	159	44	260	17	483	54%	1.1	769	7.36	86
Souris R.	Treesbank	WQ0350	1995-09-21	563	312	55%	113	40	105	13	63	167%	1.3	246	6.86	100
Souris R.	Treesbank	WQ0350	1996-09-18	562	353	63%	112	25	98	7	61	161%	2.5	191	7.09	99
Souris R.	Treesbank	WQ0350	1997-09-08	244	47	19%	49	40	113	13	35	323%	1.3	188	5.54	82
Souris R.	Treesbank	WQ0350	1998-09-15	667	305	46%	133	40	158	10	119	133%	1.3	357	6.45	92

Table 2. Summary of macroinvertebrate statistics, substrate, stream velocity at surface, and water temperature, 1995 through 1998 (continued).

Stream	Location	Site	Date	Total Organisms (N)	Dominant Taxon (n)	Dominant Taxon (%)	Organisms/ m^2	Taxa Richness	EPT (n)	EPT Index	C (n)	EPT/C	Community Loss[1]	Available HBI Organism Tolerences[2]	HBI[2]	Tolerance[3] CTQa Invert.
Marsh R.	PR 303	WQ0365	1995-09-20	667	211	32%	133	47	32	5	143	22%	1.4	538	6.61	100
Marsh R.	PR 303	WQ0365	1996-09-09	3036	2887	95%	607	32	28	6	14	200%	2.1	2989	7.97	107
Marsh R.	PR 303	WQ0365	1997-09-10	273	157	58%	55	24	49	1	4	12225%	2.7	250	7.77	100
Marsh R.	PR 303	WQ0365	1998-08-20	132	81	61%	26	18	82	2	16	513%	3.9	124	7.24	82
Cypress R.	NE of town	WQ0398	1995-09-21	795	445	56%	159	37	499	8	73	684%	1.5	779	7.11	83
Cypress R.	NE of town	WQ0398	1996-09-16	327	90	28%	65	28	119	5	111	107%	2.1	279	7.27	89
Cypress R.	NE of town	WQ0398	1997-09-08	272	132	49%	54	41	171	11	27	633%	1.3	249	5.88	78
Cypress R.	NE of town	WQ0398	1998-09-15	399	165	41%	80	42	91	10	187	49%	1.1	393	7.74	95
Waterhen R.**	Waterhen	WQ0561	1995-09-25	2368	2062	87%	474	32	131	13	105	125%	2.0	2360	7.86	106
Waterhen R.	Waterhen	WQ0561	1996-08-26	153	35	23%	31	22	79	9	12	658%	3.2	149	6.44	91
Waterhen R.	Waterhen	WQ0561	1997-08-25	300	97	32%	60	37	104	15	56	186%	1.7	269	6.31	97
Waterhen R.	Waterhen	WQ0561	1998-09-23	1375	814	59%	275	31	298	12	7	4257%	2.0	1247	6.99	96
Cooks Creek	Boundary Rd.	WQ0643	1996-09-16	185	74	40%	37	29	19	6	12	158%	2.1	184	7.53	102
Cooks Creek	Boundary Rd.	WQ0643	1997-08-20	287	70	24%	57	37	90	5	33	273%	1.5	281	6.60	88
Cooks Creek	Boundary Rd.	WQ0643	1998-09-03	203	28	14%	41	33	38	6	19	200%	1.8	177	6.98	99
Cooks Creek	S of Millbrook	WQ0644	1996-09-16	632	458	72%	126	27	474	4	26	1823%	2.4	614	6.96	79
Cooks Creek	S of Millbrook	WQ0644	1997-08-20	222	74	33%	44	19	16	3	190	8%	3.5	210	7.02	108
Pipestone Cr. Diversion	Boundary	WQ1242	1996-10-01	4749	3672	77%	950	26	18	4	1	1800%	2.7	4386	6.24	108
Pipestone Cr. Diversion	Boundary	WQ1242	1997-09-08	2935	2181	74%	587	22	5	2	0	Infinate	3.0	2917	7.56	108
Pipestone Cr. Diversion	Boundary	WQ1242	1998-09-15	2390	1621	68%	478	35	2	2	8	25%	1.9	2369	7.48	108

1. Community Loss Index (Courtemanch and Davies 1987) compares taxa within a sample or composite sample to taxa in mean of reference database.

2. HBI = Modified Hilsenhoff Biotic Index (Hilsenhoff 1987) based on tolerance values of individuals within a species using NYDEC or Hilsenhoff tolerance values if possible or alternately EPA values. Tolerance values were not available for a few species, mainly within the Order Hemiptera. Tolerance values were identified using US EPA Macroinvertebrate Species List, Version 1 (May, 1994).

3 BCI = Biotic Condition Index (Winget and Magum 1979) based on tolerance quotients of individuals within a species (CTQa) and predicted tolerance quotients based on stream gradient, substrate, total alkalinity, and sulphate (CTQp).

4. Functional Feeding Groups were identified using US EPA Macroinvertebrate Species List, Version 1 (May, 1994) with additional information from Merritt and Cummins (1984).

5. Substrate: M = Muck, C = Clay, Si = Silt, Sa = Sand, G = Gravel, Sh = Shale, P = Pebbles, Ru = Rubble, Co = Cobble, B = Boulders, Ro = Rock, and D = Detritus, listed in order of prevalence.

* Mossy R. sampling site for macroinvertebrates moved 0.8 km upstream in 1996.

** Waterhen R. sampling site for macroinvertebrates moved from east shore to west shore of the river in 1996.

Table 2. Summary of macroinvertebrate statistics, substrate, stream velocity at surface, and water temperature, 1995 through 1998 (continued).

Stream	Location	Site	Date	Tolerance[3] CTQp Phys/Chem	BCI[3]	Feeding Groups[4] Collector Gatherers	Predators	Scrapers	Filter Collectors	SC/FC	Shredders	Substrate[5]	Surface Velocity m/sec	Temperature Degrees Celcius
Boyne R.	Carman	WQ0029	1995-09-20	60	57	60%	13%	5%	13%	35%	14%	C	0.043	N/A
Boyne R.	Carman	WQ0029	1996-09-09	99	95	57%	4%	16%	26%	63%	27%	C	0.072	19.0
Boyne R.	Carman	WQ0029	1997-08-22	60	60	53%	7%	22%	15%	149%	7%	C,M,D,Sa	0.033	16.0
Boyne R.	Carman	WQ0029	1998-09-04	60	63	32%	9%	38%	15%	253%	15%	C,M	Low	17.5
Brokenhead R.	PTH 59	WQ0038	1995-09-26	60	59	79%	7%	8%	6%	131%	3%	G,Sa,Si,C,B	0.075	N/A
Brokenhead R.	PTH 59	WQ0038	1996-09-16	60	60	82%	5%	9%	3%	306%	1%	M,C,G,Sa,D,B	0.038	14.0
Brokenhead R.	PTH 59	WQ0038	1997-08-20	60	59	88%	5%	6%	1%	567%	1%	M,R,D,G,Co	Low	19.0
Brokenhead R.	PTH 59	WQ0038	1998-09-03	60	73	82%	9%	9%	1%	825%	1%	G,Ro,M,B,D,Sticks,Plants	Low	20.0
La Salle R.	St. Norbert	WQ0068	1995-09-19	60	60	27%	52%	15%	0%	Infinite	10%	C,D,Si	Low	7.0
La Salle R.	St. Norbert	WQ0068	1996-09-17	99	96	48%	35%	11%	0%	Infinite	4%	M,C,Co,Sticks	Low	15.0
La Salle R.	St. Norbert	WQ0068	1997-08-19	90	88	32%	63%	3%	1%	233%	28%	M,C,D	Low	17.0
La Salle R.	St. Norbert	WQ0068	1998-08-19	60	56	77%	16%	5%	5%	100%	61%	M,C,few Ro	0.047	18.0
L. Saskatchewan R.	PTH 25	WQ0105	1995-09-21	89	84	95%	1%	1%	3%	38%	2%	G,Sa	0.115	11.0
L. Saskatchewan R.	PTH 25	WQ0105	1996-09-18	97	94	92%	1%	6%	4%	164%	0.3%	G,Ro	0.149	17.0
L. Saskatchewan R.	PTH 25	WQ0105	1997-09-09	55	52	98%	1%	0.8%	0.5%	138%	0.3%	G,Co,Sa	0.158	15.0
L. Saskatchewan R.	PTH 25	WQ0105	1998-09-16	86	87	96%	2%	1.4%	1.5%	96%	2%	G,Ro,P	0.055	16.0
Rat R.	PR 303	WQ0131	1995-09-20	60	79	31%	2%	59%	3%	2053%	3%	Ru,Sa,G,D	0.048	0.0
Rat R.	PR 303	WQ0131	1996-09-09	90	102	43%	4%	13%	42%	32%	2%	Ru,M,Sa,Si,B,Sticks	0.714	18.0
Rat R.	PR 303	WQ0131	1997-09-10	90	98	18%	1%	23%	58%	39%	2%	C,Ro,Co,G	0.150	15.0
Rat R.	PR 303	WQ0131	1998-08-20	60	65	34%	34%	11%	2%	513%	5%	G,Co,Sa,D,C	0.175	17.0
Roseau R. Dam	W of PR200	WQ0153	1995-09-20	60	74	11%	11%	42%	3%	1375%	1%	B,C	Low	11.0
Roseau R. Dam	W of PR200	WQ0153	1996-09-09	60	105	28%	2%	50%	0%	Infinite	20%	B,C,M,Si	0.244	21.0
Roseau R. Dam	W of PR200	WQ0153	1997-08-22	60	91	22%	10%	44%	1%	4100%	27%	Ro,C,G,	0.158	20.0
Roseau R. Dam	W of PR200	WQ0153	1998-09-04	60	76	62%	14%	14%	3%	433%	17%	Si,Ro,C	0.178	20.0
Seine R.	PTH 100	WQ0166	1995-09-19	60	59	41%	18%	34%	7%	514%	8%	C,Si,D,Plants	0.120	7.0
Seine R.	PTH 100	WQ0166	1996-09-17	60	57	66%	13%	19%	4%	547%	54%	M,Si,C	0.192	11.0
Seine R.	PTH 100	WQ0166	1997-08-19	60	62	12%	43%	49%	5%	956%	1%	M,hard C,D	0.105	17.0
Seine R.	PTH 100	WQ0166	1998-08-18	60	56	7%	2%	94%	0.4%	21156%	1%	M,C nodules	Low	15.0
Whitemud R.	Westbourne	WQ0197	1995-09-21	60	96	73%	3%	8%	6%	130%	54%	B,Ru,G	0.100	9.0
Whitemud R.	Westbourne	WQ0197	1996-09-19	90	108	77%	1%	9%	17%	52%	11%	B,G	0.185	15.0
Whitemud R.	Westbourne	WQ0197	1997-09-09	60	76	73%	9%	17%	12%	135%	3%	B,G,Co	0.093	18.0
Whitemud R.	Westbourne	WQ0197	1998-09-16	60	63	43%	5%	26%	27%	96%	8%	Ro,Sa,G,some C,Sticks	NA	19.0
N. Duck R.	PTH 10	WQ0217	1995-09-26	60	58	9%	4%	1%	1%	80%	3%	B,Sa,D,G	0.104	8.0
N. Duck R.	PTH 10	WQ0217	1996-08-27	60	61	24%	67%	0%	6%	0%	3%	B,G,Plants,Si	0.233	19.0
N. Duck R.	PTH 10	WQ0217	1997-08-26	60	65	33%	57%	3%	4%	88%	3%	Sa,G,B,Ro,Plants	0.245	18.0
N. Duck R.	PTH 10	WQ0217	1998-09-22	60	57	7%	83%	0.9%	0.6%	150%	5%	Sa,Co,some Ro,Si	0.066	11.0
Sclater R.	PTH 20	WQ0220	1995-09-26	60	63	4%	35%	2%	4%	50%	6%	Co,G,D,B,Si	Low	11.0
Sclater R.	PTH 20	WQ0220	1996-08-27	60	89	89%	1%	5%	2%	286%	9%	G,Co,B	0.345	20.0
Sclater R.	PTH 20	WQ0220	1997-08-26	60	71	75%	10%	12%	2%	700%	3%	G,Ro,Sa	Low	20.0
Sclater R.	PTH 20	WQ0220	1998-09-22	60	65	39%	59%	1%	1%	100%	2%	Ro,Co,some Si	Low	15.0
Fishing R.	PTH 20	WQ0223	1995-09-25	60	60	31%	14%	41%	1%	8100%	11%	Co,Si,Sa,D	Low	N/A
Fishing R.	PTH 20	WQ0223	1996-08-26	60	60	45%	2%	45%	5%	950%	7%	Co,R,Sa,G	0.294	21.0
Fishing R.	PTH 20	WQ0223	1997-08-25	60	77	59%	2%	33%	5%	675%	4%	Co,R,G,Sa	0.129	20.0
Fishing R.	PTH 20	WQ0223	1998-09-24	60	104	58%	4%	38%	0%	Infinate	14%	Co,B,some Sa,G	Low	11.0

Table 2. Summary of macroinvertebrate statistics, substrate, stream velocity at surface, and water temperature, 1995 through 1998 (continued).

Stream	Location	Site	Date	Tolerance[3] CTQp Phys/Chem	BCI[3]	Feeding Groups[4] Collector Gatherers	Predators	Scrapers	Filter Collectors	SC/FC	Shredders	Substrate[5]	Surface Velocity m/sec	Temperature Degrees Celcius
Mossy R.	PR 364	WQ0226	1995-09-25	60	71	49%	6%	40%	8%	490%	3%	Co,C,Si	0.371	10.0
Mossy R.*	PR 364	WQ0226	1996-08-26	60	66	41%	16%	37%	9%	410%	4%	M,Si,few B	0.455	22.0
Mossy R.	PR 364	WQ0226	1997-08-25	60	74	66%	8%	21%	5%	407%	2%	M,D	0.258	20.0
Mossy R.	PR 364	WQ0226	1998-09-23	60	77	43%	18%	28%	1%	2367%	9%	C,Si,M, some G,D,Slicks	0.278	16.0
Ochre R.	PTH 20	WQ0227	1995-09-25	60	87	84%	11%	3%	3%	100%	8%	B,Co,Sa	0.056	9.0
Ochre R.	PTH 20	WQ0227	1996-08-26	60	102	83%	11%	5%	2%	250%	0%	Sa,Si,B	0.083	20.0
Ochre R.	PTH 20	WQ0227	1997-08-27	60	50	45%	50%	0.7%	4%	18%	9%	Sa,Ro,M	NA	17.0
Ochre R.	PTH 20	WQ0227	1998-09-21	60	50	11%	66%	23%	7%	342%	11%	Ro,Co	0.655	10.0
Pine R.	PTH 20	WQ0233	1995-09-26	60	62	37%	25%	23%	10%	223%	2%	Si,G,B	0.047	11.0
Pine R.	PTH 20	WQ0233	1996-08-27	60	63	56%	22%	8%	16%	48%	25%	M,Si,G,B	0.182	20.0
Pine R.	PTH 20	WQ0233	1997-08-26	60	63	54%	27%	19%	7%	286%	7%	Sa,Ro,M,G,Co	Low	22.0
Pine R.	PTH 20	WQ0233	1998-09-23	60	64	48%	39%	13%	1%	1188%	1%	Si,C,some Co	Low	11.0
Swan R.	PR 268	WQ0244	1995-09-26	60	77	83%	8%	11%	14%	78%	5%	Sa	0.328	9.0
Swan R.	PR 268	WQ0244	1996-08-27	60	79	59%	10%	12%	17%	71%	2%	Sa,G,Si	0.606	20.0
Swan R.	PR 268	WQ0244	1997-08-26	60	87	58%	9%	21%	18%	114%	1%	Sa,M,G	0.056	18.0
Swan R.	PR 268	WQ0244	1998-09-22	60	91	55%	16%	9%	3%	275%	25%	S,some P,Ro,D	0.208	10.0
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1995-09-25	60	61	17%	10%	11%	54%	21%	1%	Sa,G,B	Low	8.0
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1996-08-26	60	57	7%	7%	1%	79%	2%	1%	P,Co,B,little Si	0.083	21.0
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1997-08-27	60	57	15%	5%	8%	67%	12%	3%	G,Co,Sa,M,Ro	Low	19.0
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1998-09-21	60	58	12%	29%	5%	3%	200%	2%	Ro,C,some Co,G,D	0.721	10.0
Valley R.	PTH 20	WQ0250	1995-09-25	60	69	30%	34%	22%	9%	228%	22%	G,Sa,B,D	0.388	10.0
Valley R.	PTH 20	WQ0250	1996-08-26	60	63	54%	8%	6%	37%	17%	8%	Sa,Si,few B	1.100	20.0
Valley R.	PTH 20	WQ0250	1997-08-25	60	79	66%	9%	18%	17%	106%	2%	G,Ro,M,Co	0.479	21.0
Valley R.	PTH 20	WQ0250	1998-09-21	60	139	90%	10%	3%	4%	67%	42%	Ro,Co,G	0.136	16.0
Vermilion R.	PTH 20	WQ0252	1995-09-25	60	124	65%	13%	20%	1%	3700%	37%	G,Sa	Low	8.0
Vermilion R.	PTH 20	WQ0252	1996-08-28	60	59	33%	6%	7%	13%	54%	0%	Si,M,Sa,Sh	0.059	20.0
Vermilion R.	PTH 20	WQ0252	1997-08-25	60	75	68%	10%	14%	8%	168%	2%	Sa,G,Co,R	0.094	22.0
Vermilion R.	PTH 20	WQ0252	1998-09-24	60	65	19%	10%	14%	60%	24%	2%	G,P	1.000	15.0
Edwards Cr.	PTH 5/10	WQ0253	1995-09-25	60	65	49%	9%	3%	38%	7%	10%	Sh,G,B,Si,D	0.212	7.0
Edwards Cr.	PTH 5/10	WQ0253	1996-08-28	60	63	47%	3%	45%	3%	1568%	4%	Ro,G,Sa,D,M	0.263	20.5
Edwards Cr.	PTH 5/10	WQ0253	1997-08-27	60	78	65%	9%	6%	19%	33%	3%	Sh,G,Ro	0.149	16.0
Edwards Cr.	PTH 5/10	WQ0253	1998-09-24	60	98	70%	23%	3%	5%	67%	8%	G,B,some Si,D	0.278	11.0
Wilson R.	PTH 20	WQ0255	1995-09-25	90	143	56%	33%	9%	1%	1300%	45%	Sa,G,some Co,B	Low	10.0
Wilson R.	PTH 20	WQ0255	1996-08-28	90	112	64%	6%	20%	10%	192%	15%	G,Si,M,some D,B	0.076	20.0
Wilson R.	PTH 20	WQ0255	1997-08-25	60	58	22%	57%	14%	5%	267%	18%	G,M,Sa,Co,G	Low	21.5
Wilson R.	PTH 20	WQ0255	1998-09-21	60	95	28%	17%	55%	1%	6300%	3%	G,Co,B,Si	0.033	15.0
Woody R.	PR 268	WQ0259	1995-09-26	60	64	42%	10%	0%	20%	0%	2%	Sa	0.749	9.0
Woody R.	PR 268	WQ0259	1996-08-27	60	59	81%	2%	2%	12%	20%	2%	Sa,Si	1.250	22.0
Woody R.	PR 268	WQ0259	1997-08-26	60	110	74%	8%	2%	12%	18%	8%	Sa,G,Ro	0.314	16.5
Woody R.	PR 268	WQ0259	1998-09-22	60	70	78%	11%	4%	2%	200%	63%	Sa,G,D, some Si	0.228	8.0
Souris R.	Treesbank	WQ0350	1995-09-21	108	108	20%	61%	10%	8%	128%	11%	Sh,G,Sa	0.524	9.0
Souris R.	Treesbank	WQ0350	1996-09-18	108	109	22%	68%	7%	1%	780%	4%	Sh,G,some Ro,Si	Low	16.0
Souris R.	Treesbank	WQ0350	1997-09-08	99	120	47%	24%	17%	4%	467%	7%	G,Sa,P,Ro,M	0.150	17.0
Souris R.	Treesbank	WQ0350	1998-09-15	99	107	37%	50%	8%	2%	509%	18%	Sa,G,some M	0.330	17.0

Table 2. Summary of macroinvertebrate statistics, substrate, stream velocity at surface, and water temperature, 1995 through 1998 (continued).

Stream	Location	Site	Date	Tolerance[3] CTQp Phys/Chem	BCI[3]	Feeding Groups[4] Collector Gatherers	Predators	Scrapers	Filter Collectors	SC/FC	Shredders	Substrate[5]	Surface Velocity m/sec	Temperature Degrees Celcius
Marsh R.	PR 303	WQ0365	1995-09-20	60	60	51%	25%	5%	4%	135%	30%	D,Si	Low	10.0
Marsh R.	PR 303	WQ0365	1996-09-09	90	84	96%	2%	0.3%	0.4%	75%	1%	M,C	0.014	18.0
Marsh R.	PR 303	WQ0365	1997-09-10	60	60	79%	12%	3%	6%	50%	1%	C,D,little Sa,G	0.064	19.0
Marsh R.	PR 303	WQ0365	1998-08-20	60	73	77%	17%	1.5%	3%	50%	5%	M,C, some G, Plants	Low	22.0
Cypress R.	NE of town	WQ0398	1995-09-21	108	130	80%	4%	17%	6%	275%	9%	Sh,G,Si	0.413	7.5
Cypress R.	NE of town	WQ0398	1996-09-18	99	111	81%	11%	4%	3%	127%	28%	Sh,G,M,some B	0.057	16.0
Cypress R.	NE of town	WQ0398	1997-09-08	90	115	69%	18%	8%	5%	157%	2%	G,Co,M,Sa,C	0.091	15.0
Cypress R.	NE of town	WQ0398	1998-09-15	90	94	70%	6%	12%	14%	85%	43%	G,Sh,Si,Ro,M,D	0.099	13.0
Waterhen R.**	Waterhen	WQ0561	1995-09-25	60	57	92%	4%	1%	1%	50%	2%	Ro,Co,Si,D,hard C	0.214	10.0
Waterhen R.	Waterhen	WQ0561	1996-08-26	60	66	65%	2%	6%	29%	20%	12%	Ro,Co	0.909	21.0
Waterhen R.	Waterhen	WQ0561	1997-08-25	60	62	61%	2%	9%	25%	37%	5%	Co,G,M	0.880	20.0
Waterhen R.	Waterhen	WQ0561	1998-09-23	60	63	67%	7%	14%	2%	762%	2%	Co,G,R. some Si	0.769	12.5
Cooks Creek	Boundary Rd.	WQ0643	1996-09-16	90	89	51%	11%	29%	5%	600%	9%	hard C,Sa,G,few B	0.021	14.0
Cooks Creek	Boundary Rd.	WQ0643	1997-08-20	90	102	44%	17%	34%	4%	891%	8%	Sa,Si,,G,C,Ro,M,B	Low	18.0
Cooks Creek	Boundary Rd.	WQ0643	1998-09-03	90	91	46%	9%	34%	5%	636%	9%	R,M,Co,G	Low	16.0
Cooks Creek	S of Millbrook	WQ0644	1996-09-16	60	76	84%	11%	4%	0.2%	2700%	1%	C,M	0.172	17.0
Cooks Creek	S of Millbrook	WQ0644	1997-08-20	60	56	62%	13%	0.45%	26%	2%	18%	C nodules	Low	15.0
Pipestone Cr. Diversion	Boundary	WQ1242	1996-10-01	90	84	89%	5%	0.4%	0.1%	300%	77%	Sa	Low	7.0
Pipestone Cr. Diversion	Boundary	WQ1242	1997-09-08	90	84	96%	1%	1%	3%	18%	21%	C,Si,M	Low	16.0
Pipestone Cr. Diversion	Boundary	WQ1242	1998-09-15	90	84	92%	4%	0.4%	3%	13%	24%	M,C	Low	17.0

1. Community Loss Index (Courtemanch and Davies 1987) compares taxa within a sample or composite sample to taxa in mean of reference database.

2. HBI = Modified Hilsenhoff Biotic Index (Hilsenhoff 1987) based on tolerance values of individuals within a species using NYDEC or Hilsenhoff tolerance values if possible or alternately EPA values. Tolerance values were not available for a few species, mainly within the Order Hemiptera. Tolerance values were identified using US EPA Macroinvertebrate Species List, Version 1 (May, 1994).

3 BCI = Biotic Condition Index (Winget and Magum 1979) based on tolerance quotients of individuals within a species (CTQa) and predicted tolerance quotients based on stream gradient, substrate, total alkalinity, and sulphate (CTQp).

4. Functional Feeding Groups were identified using US EPA Macroinvertebrate Species List, Version 1 (May, 1994) with additional information from Merritt and Cummins (1984).

5. Substrate: M = Muck, C = Clay, Si = Silt, Sa = Sand, G = Gravel, Sh = Shale, P = Pebbles, Ru = Rubble, Co = Cobble, B = Boulders, Ro = Rock, and D = Detritus, listed in order of prevalence.

* Mossy R. sampling site for macroinvertebrates moved 0.8 km upstream in 1996.

** Waterhen R. sampling site for macroinvertebrates moved from east shore to west shore of the river in 1996.

Table 3. Summary of macroinvertebrate bioassessment criteria and Biological Condition Categories.

Stream	Location	Site	Date	Dominant Taxon[1] Score	Taxa Richness Score*	EPT Index Score*	EPT/C Score*	Community Loss[2] Score	HBI Score*	BCI[3] Score	% Shredders Score*	Sum Score*	Mean Score*	Relative to Average of Best Site Scores[4]	Biological Condition Category[4] (Relative Impairment)
Boyne R.	Carman	WQ0029	1995-09-20	4	4	0	0	2	2	0	6	18.00	2.25	52.9%	Moderate-Slight
Boyne R.	Carman	WQ0029	1996-09-09	4	6	0	0	2	2	6	6	26.00	3.25	76.5%	Slight
Boyne R.	Carman	WQ0029	1997-08-22	4	6	0	0	4	2	0	4	20.00	2.50	58.8%	Slight
Boyne R.	Carman	WQ0029	1998-09-04	2	6	0	0	2	2	0	6	18.00	2.25	52.9%	Moderate-Slight
			Best Score	4	6	0	0	4	2	6	6				
Brokenhead R.	PTH 59	WQ0038	1995-09-26	0	6	0	0	2	2	0	2	12.06	1.51	35.5%	Moderate
Brokenhead R.	PTH 59	WQ0038	1996-09-16	0	6	0	2	2	2	0	0	12.00	1.50	35.3%	Moderate
Brokenhead R.	PTH 59	WQ0038	1997-08-20	0	6	2	2	4	2	0	0	16.00	2.00	47.1%	Moderate
Brokenhead R.	PTH 59	WQ0038	1998-09-03	0	6	2	6	4	2	2	0	22.00	2.75	64.7%	Slight
			Best Score	0	6	2	6	4	2	2	2				
La Salle R.	St. Norbert	WQ0068	1995-09-19	2	4	0	0	2	2	0	6	16.30	2.04	47.9%	Moderate
La Salle R.	St. Norbert	WQ0068	1996-09-17	2	2	0	0	0	2	6	2	14.00	1.75	41.2%	Moderate
La Salle R.	St. Norbert	WQ0068	1997-08-19	0	4	0	0	2	2	6	0	14.00	1.75	41.2%	Moderate
La Salle R.	St. Norbert	WQ0068	1998-08-19	0	0	0	0	0	0	0	6	6.00	0.75	17.6%	Severe-Moderate
			Best Score	2	4	0	0	2	2	6	6				
L. Saskatchewan R.	PTH 25	WQ0105	1995-09-21	0	6	6	0	4	2	4	0	22.00	2.75	64.7%	Slight
L. Saskatchewan R.	PTH 25	WQ0105	1996-09-18	0	6	6	6	4	2	6	0	30.00	3.75	88.2%	Nonimpaired
L. Saskatchewan R.	PTH 25	WQ0105	1997-09-09	0	6	2	0	4	2	0	0	14.00	1.75	41.2%	Moderate
L. Saskatchewan R.	PTH 25	WQ0105	1998-09-16	0	6	6	4	4	2	6	0	26.00	3.25	76.5%	Slight
			Best Score	0	6	6	0	4	2	6	0				
Rat R.	PR 303	WQ0131	1995-09-20	2	6	6	6	4	6	2	2	34.00	4.25	100.0%	Nonimpaired
Rat R.	PR 303	WQ0131	1996-09-09	4	6	2	6	2	4	6	0	30.00	3.75	88.2%	Nonimpaired
Rat R.	PR 303	WQ0131	1997-09-10	0	6	4	6	2	6	6	0	30.00	3.75	88.2%	Nonimpaired
Rat R.	PR 303	WQ0131	1998-08-20	4	6	6	4	4	4	0	4	32.00	4.00	94.1%	Nonimpaired
			Best Score	4	6	6	6	4	6	6	4				
Roseau R. Dam	W of PR 200	WQ0153	1995-09-20	2	4	4	6	2	6	2	0	26.00	3.25	76.5%	Slight
Roseau R. Dam	W of PR 200	WQ0153	1996-09-09	0	2	4	6	0	6	6	6	30.00	3.75	88.2%	Nonimpaired
Roseau R. Dam	W of PR 200	WQ0153	1997-08-22	4	6	6	6	2	6	6	6	42.00	5.25	123.5%	Nonimpaired
Roseau R. Dam	W of PR 200	WQ0153	1998-09-04	6	6	6	2	2	4	2	6	34.00	4.25	100.0%	Nonimpaired
			Best Score	6	6	6	6	2	6	6	6				
Seine R.	PTH 100	WQ0166	1995-09-19	4	6	2	0	2	2	0	6	22.00	2.75	64.7%	Slight
Seine R.	PTH 100	WQ0166	1996-09-17	0	6	0	0	2	2	0	6	16.00	2.00	47.1%	Moderate
Seine R.	PTH 100	WQ0166	1997-08-19	4	6	0	0	2	2	0	0	14.00	1.75	41.2%	Moderate
Seine R.	PTH 100	WQ0166	1998-08-18	0	6	0	0	2	2	6	0	10.00	1.25	29.4%	Moderate
			Best Score	4	6	2	0	2	2	0	6				
Whitemud R.	Westbourne	WQ0197	1995-09-21	2	6	6	0	2	4	6	6	32.00	4.00	94.1%	Nonimpaired
Whitemud R.	Westbourne	WQ0197	1996-09-19	2	6	6	2	2	4	6	6	34.00	4.25	100.0%	Nonimpaired
Whitemud R.	Westbourne	WQ0197	1997-09-09	4	6	6	2	4	4	2	2	30.00	3.75	88.2%	Nonimpaired
Whitemud R.	Westbourne	WQ0197	1998-09-16	6	6	2	0	4	4	0	6	28.00	3.50	82.4%	Slight-Nonimpaired
			Best Score	6	6	6	0	4	4	6	6				
N. Duck R.	PTH 10	WQ0217	1995-09-26	0	6	4	6	2	6	0	2	26.00	3.25	76.5%	Slight
N. Duck R.	PTH 10	WQ0217	1996-08-27	0	2	0	2	0	6	0	2	12.00	1.50	35.3%	Moderate
N. Duck R.	PTH 10	WQ0217	1997-08-26	0	6	6	2	2	6	0	2	24.00	3.00	70.6%	Slight
N. Duck R.	PTH 10	WQ0217	1998-09-22	0	6	4	0	2	2	0	4	18.00	2.25	52.9%	Moderate-Slight
			Best Score	0	6	6	6	2	6	0	4				
Sclater R.	PTH 20	WQ0220	1995-09-26	2	6	0	0	2	2	0	4	16.00	2.00	47.1%	Moderate
Sclater R.	PTH 20	WQ0220	1996-08-27	4	6	6	4	2	2	0	6	30.00	3.75	88.2%	Nonimpaired
Sclater R.	PTH 20	WQ0220	1997-08-26	4	6	2	4	4	2	2	2	26.00	3.25	76.5%	Slight
Sclater R.	PTH 20	WQ0220	1998-09-22	0	2	0	0	0	2	0	0	4.00	0.50	11.8%	Severe
			Best Score	4	6	6	4	4	2	2	6				

Table 3. Summary of macroinvertebrate bioassessment criteria and Biological Condition Categories (continued).

Fishing R.	PTH 20	WQ0223	1995-09-25	2	6	0	0	2	2	0	6	18.00	2.25	52.9%	Moderate-Slight
Fishing R.	PTH 20	WQ0223	1996-08-26	4	4	0	2	0	2	0	4	16.00	2.00	47.1%	Moderate
Fishing R.	PTH 20	WQ0223	1997-08-25	4	4	4	2	2	4	2	2	24.00	3.00	70.6%	Slight
Fishing R.	PTH 20	WQ0223	1998-09-24	2	2	6	6	0	6	6	6	34.00	4.25	100.0%	Nonimpaired
			Best Score	4	6	6	6	2	6	6	6				
Mossy R.	PR 364	WQ0226	1995-09-25	2	6	6	6	2	4	2	2	30.00	3.75	88.2%	Nonimpaired
Mossy R.	PR 364	WQ0226	1996-08-26	4	6	2	0	2	2	0	2	18.00	2.25	52.9%	Moderate-Slight
Mossy R.	PR 364	WQ0226	1997-08-25	4	6	2	2	2	2	2	0	20.00	2.50	58.8%	Slight
Mossy R.	PR 364	WQ0226	1998-09-23	4	6	6	2	2	4	2	6	32.00	4.00	94.1%	Nonimpaired
			Best Score	4	6	6	6	2	4	2	6				
Ochre R.	PTH 20	WQ0227	1995-09-25	0	2	4	6	0	4	6	6	28.00	3.50	82.4%	Slight-Nonimpaired
Ochre R.	PTH 20	WQ0227	1996-08-26	0	4	6	6	2	6	6	0	30.00	3.75	88.2%	Nonimpaired
Ochre R.	PTH 20	WQ0227	1997-08-27	0	6	2	0	2	4	0	6	20.00	2.50	58.8%	Slight
Ochre R.	PTH 20	WQ0227	1998-09-21	4	6	6	6	2	4	2	6	36.00	4.50	105.9%	Nonimpaired
			Best Score	4	6	6	6	2	6	6	6				
Pine R.	PTH 20	WQ0233	1995-09-26	6	6	6	0	4	2	0	0	24.00	3.00	70.6%	Nonimpaired
Pine R.	PTH 20	WQ0233	1996-08-27	4	6	0	0	2	2	0	6	20.00	2.50	58.8%	Slight
Pine R.	PTH 20	WQ0233	1997-08-26	4	6	0	0	4	2	0	4	20.00	2.50	58.8%	Slight
Pine R.	PTH 20	WQ0233	1998-09-23	6	6	0	0	2	2	0	0	16.00	2.00	47.1%	Moderate
			Best Score	6	6	6	0	4	2	0	6				
Swan R.	PR 268	WQ0244	1995-09-26	0	0	0	6	0	6	2	4	18.00	2.25	52.9%	Moderate-Slight
Swan R.	PR 268	WQ0244	1996-08-27	4	2	0	2	0	4	2	0	14.00	1.75	41.2%	Moderate
Swan R.	PR 268	WQ0244	1997-08-26	6	4	6	2	2	6	6	0	32.00	4.00	94.1%	Nonimpaired
Swan R.	PR 268	WQ0244	1998-09-22	2	4	4	2	2	6	6	6	32.00	4.00	94.1%	Nonimpaired
			Best Score	6	4	6	6	2	6	6	6				
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1995-09-25	0	6	0	0	2	2	0	0	10.00	1.25	29.4%	Moderate
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1996-08-26	0	6	4	0	2	2	0	0	14.00	1.75	41.2%	Moderate
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1997-08-27	0	6	0	0	2	2	0	2	12.00	1.50	35.3%	Moderate
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1998-09-21	0	6	2	0	4	2	0	0	14.00	1.75	41.2%	Moderate
			Best Score	0	6	4	0	4	2	0	2				
Valley R.	PTH 20	WQ0250	1995-09-25	6	6	6	0	2	6	0	6	32.00	4.00	94.1%	Nonimpaired
Valley R.	PTH 20	WQ0250	1996-08-26	2	4	0	0	2	2	0	6	16.00	2.00	47.1%	Moderate
Valley R.	PTH 20	WQ0250	1997-08-25	6	6	6	2	2	6	2	0	30.00	3.75	88.2%	Nonimpaired
Valley R.	PTH 20	WQ0250	1998-09-21	0	2	0	4	0	6	6	6	24.00	3.00	70.6%	Slight
			Best Score	6	6	6	4	2	6	6	6				
Vermilion R.	PTH 20	WQ0252	1995-09-25	2	4	2	6	2	6	6	6	34.00	4.25	100.0%	Nonimpaired
Vermilion R.	PTH 20	WQ0252	1996-08-28	0	6	2	0	2	2	0	0	12.00	1.50	35.3%	Moderate
Vermilion R.	PTH 20	WQ0252	1997-08-25	0	6	4	6	2	2	2	0	22.00	2.75	64.7%	Slight
Vermilion R.	PTH 20	WQ0252	1998-09-24	2	6	4	2	2	2	0	0	18.00	2.25	52.9%	Moderate-Slight
			Best Score	2	6	4	6	2	6	6	6				
Edwards Cr.	PTH 5/10	WQ0253	1995-09-25	4	6	6	0	4	4	0	6	30.00	3.75	88.2%	Nonimpaired
Edwards Cr.	PTH 5/10	WQ0253	1996-08-28	0	6	6	0	4	2	0	2	20.00	2.50	58.8%	Slight
Edwards Cr.	PTH 5/10	WQ0253	1997-08-27	2	6	6	6	4	4	2	2	32.00	4.00	94.1%	Nonimpaired
Edwards Cr.	PTH 5/10	WQ0253	1998-09-24	2	2	2	0	0	6	6	6	24.00	3.00	70.6%	Slight
			Best Score	4	6	6	6	4	6	6	6				
Wilson R.	PTH 20	WQ0255	1995-09-25	0	4	0	6	2	6	6	6	30.00	3.75	88.2%	Nonimpaired
Wilson R.	PTH 20	WQ0255	1996-08-28	2	6	2	0	2	2	6	6	26.00	3.25	76.5%	Slight
Wilson R.	PTH 20	WQ0255	1997-08-25	0	4	0	0	2	4	0	6	16.00	2.00	47.1%	Moderate
Wilson R.	PTH 20	WQ0255	1998-09-21	0	4	6	6	2	6	6	2	32.00	4.00	94.1%	Nonimpaired
			Best Score	2	6	6	6	2	6	6	6				

Table 3. Summary of macroinvertebrate bioassessment criteria and Biological Condition Categories (continued).

Woody R.	PR 268	WQ0259	1995-09-26	6	6	4	0	2	4	0	0	22.00	2.75	64.7%	Slight
Woody R.	PR 268	WQ0259	1996-08-27	2	0	0	0	0	2	0	0	4.00	0.50	11.8%	Severe
Woody R.	PR 268	WQ0259	1997-08-26	0	6	6	4	4	4	6	6	36.00	4.50	105.9%	Nonimpaired
Woody R.	PR 268	WQ0259	1998-09-22	0	6	6	0	4	2	2	6	26.00	3.25	76.5%	Slight
			Best Score	6	6	6	4	4	4	6	6				
Souris R.	Treesbank	WQ0350	1995-09-21	0	6	6	0	4	2	6	6	30.00	3.75	88.2%	Nonimpaired
Souris R.	Treesbank	WQ0350	1996-09-18	0	6	2	0	2	2	6	2	20.00	2.50	58.8%	Slight
Souris R.	Treesbank	WQ0350	1997-09-08	6	6	6	2	4	4	6	4	38.00	4.75	111.8%	Nonimpaired
Souris R.	Treesbank	WQ0350	1998-09-15	0	6	6	0	4	2	6	6	30.00	3.75	88.2%	Nonimpaired
			Best Score	6	6	6	2	4	4	6	6				
Marsh R.	PR 303	WQ0365	1995-09-20	2	6	0	0	4	2	0	6	20.00	2.50	58.8%	Slight
Marsh R.	PR 303	WQ0365	1996-09-09	0	6	0	0	2	2	4	0	14.00	1.75	41.2%	Moderate
Marsh R.	PR 303	WQ0365	1997-09-10	0	6	0	6	2	2	0	0	16.00	2.00	47.1%	Moderate
Marsh R.	PR 303	WQ0365	1998-08-20	0	4	0	2	2	2	2	4	16.00	2.00	47.1%	Moderate
			Best Score	2	6	0	6	4	2	4	6				
Cypress R.	NE of town	WQ0398	1995-09-21	0	6	2	4	4	2	6	6	30.00	3.75	88.2%	Nonimpaired
Cypress R.	NE of town	WQ0398	1996-09-18	4	6	0	0	2	2	6	6	26.00	3.25	76.5%	Slight
Cypress R.	NE of town	WQ0398	1997-09-08	0	6	6	4	4	4	6	0	30.00	3.75	88.2%	Nonimpaired
Cypress R.	NE of town	WQ0398	1998-09-15	0	6	6	0	4	2	6	6	30.00	3.75	88.2%	Nonimpaired
			Best Score	4	6	6	4	4	4	6	6				
Waterhen R.	Waterhen	WQ0561	1995-09-25	0	6	6	0	2	2	0	0	16.00	2.00	47.1%	Moderate
Waterhen R.	Waterhen	WQ0561	1996-08-26	4	4	4	4	2	2	0	6	26.00	3.25	76.5%	Slight
Waterhen R.	Waterhen	WQ0561	1997-08-25	2	6	6	0	2	4	0	4	24.00	3.00	70.6%	Slight
Waterhen R.	Waterhen	WQ0561	1998-09-23	0	6	6	6	2	2	0	0	22.00	2.75	64.7%	Slight
			Best Score	4	6	6	6	2	4	0	6				
Cooks Creek	Boundary Rd.	WQ0643	1996-09-16	2	6	0	0	2	2	6	6	24.00	3.00	70.6%	Slight
Cooks Creek	Boundary Rd.	WQ0643	1997-08-20	4	6	0	0	4	2	6	6	28.00	3.50	82.4%	Slight-Nonimpaired
Cooks Creek	Boundary Rd.	WQ0643	1998-09-03	6	6	0	0	2	2	6	6	28.00	3.50	82.4%	Slight-Nonimpaired
			Best Score	6	6	0	0	4	2	6	6				
Cooks Creek	S of Millbrook	WQ0644	1996-09-16	0	6	0	6	2	2	2	0	18.00	2.25	52.9%	Moderate-Slight
Cooks Creek	S of Millbrook	WQ0644	1997-08-20	2	4	0	0	2	2	0	6	16.00	2.00	47.1%	Moderate
			Best Score	2	6	0	6	2	2	2	6				
Pipestone Cr. Diversion	Boundary	WQ1242	1996-10-01	0	6	0	6	2	4	4	6	28.00	3.50	82.4%	Slight-Nonimpaired
Pipestone Cr. Diversion	Boundary	WQ1242	1997-09-08	0	4	0	6	2	2	4	6	24.00	3.00	70.6%	Slight
Pipestone Cr. Diversion	Boundary	WQ1242	1998-09-15	0	6	0	0	2	2	4	6	20.00	2.50	58.8%	Slight
			Best Score	0	6	0	6	2	4	4	6				
	Mean Score			2	5	3	2	2	3	2	3	22.97	2.87	67.5%	
	Mean of All Best Site Scores[a]			4	6	4	4	3	4	4	5	34.01	4.25[a]		

[a] Biological Condition Scores are relative to best scores in pooled samples collected from the North Duck River in the years 1995 through 1998, except for scores for contribution of dominant taxon, Community Loss, and BCI as noted below.

1. Dominant Taxon score is based on range of values obtained.

2. Community Loss relative to data base composite sample. Score is based on range of values obtained.

3. BCI = Biotic Condition Index (Winget and Magum, 1979) based on tollerance quotients of indivuals within a species (CTQa) and predicted tollerance quotients based on stream gradient, substrate, total alkalainity, and sulphate (CTQp). Score is based on range of values obtained.

4. Biological Condition Categories are the result of the bioassessment based on % comparison to reference mean score which is the overall mean of all best site scores[a]. The bioassessment is described in the fourth step of Figure 2.

a. Overall mean of all best site scores.

Table 4. Comparison of macroinvertebrate biological condition scores to Canadian Water Quality Index based on water chemistry, physical and bacteriological data.

Stream	Location	Site	Year	Biological Score % of Highest Score	Biological Condition Relative Impairment	CWQI Score	Canadian Water Quality Index Rating[1]
Boyne R.	Carman	WQ0029	1995	52.9%	Moderate-Slight	77	Fair*
Boyne R.	Carman	WQ0029	1996	76.5%	Slight	89	Good*
Boyne R.	Carman	WQ0029	1997	58.8%	Slight	77	Fair*
Boyne R.	Carman	WQ0029	1998	52.9%	Moderate-Slight	73	Fair*
Brokenhead R.	PTH 59	WQ0038	1995	35.5%	Moderate	95	Excellent*
Brokenhead R.	PTH 59	WQ0038	1996	35.3%	Moderate	88	Good*
Brokenhead R.	PTH 59	WQ0038	1997	47.1%	Moderate	91	Good*
Brokenhead R.	PTH 59	WQ0038	1998	64.7%	Slight	87	Good*
La Salle R.	St. Norbert	WQ0068	1995	47.9%	Moderate	61	Fair
La Salle R.	St. Norbert	WQ0068	1996	41.2%	Moderate	65	Fair
La Salle R.	St. Norbert	WQ0068	1997	41.2%	Moderate	62	Fair
La Salle R.	St. Norbert	WQ0068	1998	17.6%	Severe-Moderate	64	Fair
L. Saskatchewan R.	PTH 25	WQ0105	1995	64.7%	Slight	85	Good*
L. Saskatchewan R.	PTH 25	WQ0105	1996	88.2%	Nonimpaired	72	Fair*
L. Saskatchewan R.	PTH 25	WQ0105	1997	41.2%	Moderate	91	Good*
L. Saskatchewan R.	PTH 25	WQ0105	1998	76.5%	Slight	85	Good*
Rat R.	PR 303	WQ0131	1995	100.0%	Nonimpaired	83	Good*
Rat R.	PR 303	WQ0131	1996	88.2%	Nonimpaired	81	Good*
Rat R.	PR 303	WQ0131	1997	88.2%	Nonimpaired	75	Fair*
Rat R.	PR 303	WQ0131	1998	94.1%	Nonimpaired	82	Good*
Roseau R. Dam	W of PR200	WQ0153	1995	76.5%	Slight	88	Good*
Roseau R. Dam	W of PR200	WQ0153	1996	88.2%	Nonimpaired	79	Fair*
Roseau R. Dam	W of PR200	WQ0153	1997	123.5%	Nonimpaired	81	Good*
Roseau R. Dam	W of PR200	WQ0153	1998	100.0%	Nonimpaired	79	Fair*
Seine R.	PTH 100	WQ0166	1995	64.7%	Slight	43	Poor*
Seine R.	PTH 100	WQ0166	1996	47.1%	Moderate	71	Fair*
Seine R.	PTH 100	WQ0166	1997	41.2%	Moderate	81	Good*
Seine R.	PTH 100	WQ0166	1998	29.4%	Moderate	78	Fair*
Whitemud R.	Westbourne	WQ0197	1995	94.1%	Nonimpaired	88	Good*
Whitemud R.	Westbourne	WQ0197	1996	100.0%	Nonimpaired	91	Good*
Whitemud R.	Westbourne	WQ0197	1997	88.2%	Nonimpaired	86	Good*
Whitemud R.	Westbourne	WQ0197	1998	82.4%	Slight-Nonimpaired	76	Fair*
N. Duck R.	PTH 10	WQ0217	1995	76.5%	Slight	86	Good*
N. Duck R.	PTH 10	WQ0217	1996	35.3%	Moderate	90	Good*
N. Duck R.	PTH 10	WQ0217	1997	70.6%	Slight	75	Fair*
N. Duck R.	PTH 10	WQ0217	1998	52.9%	Moderate-Slight	87	Good*
Sclater R.	PTH 20	WQ0220	1995	47.1%	Moderate	82	Good*
Sclater R.	PTH 20	WQ0220	1996	88.2%	Nonimpaired	95	Excellent*
Sclater R.	PTH 20	WQ0220	1997	76.5%	Slight	91	Good*
Sclater R.	PTH 20	WQ0220	1998	11.8%	Severe	93	Good*
Fishing R.	PTH 20	WQ0223	1995	52.9%	Moderate-Slight	77	Fair*
Fishing R.	PTH 20	WQ0223	1996	47.1%	Moderate	88	Good*
Fishing R.	PTH 20	WQ0223	1997	70.6%	Slight	83	Good*
Fishing R.	PTH 20	WQ0223	1998	100.0%	Nonimpaired	92	Good*
Mossy R.	PR 364	WQ0226	1995	88.2%	Nonimpaired	90	Good*
Mossy R.*	PR 364	WQ0226	1996	52.9%	Moderate-Slight	87	Good*
Mossy R.	PR 364	WQ0226	1997	58.8%	Slight	78	Fair*
Mossy R.	PR 364	WQ0226	1998	94.1%	Nonimpaired	82	Good*
Ochre R.	PTH 20	WQ0227	1995	82.4%	Slight-Nonimpaired	75	Fair
Ochre R.	PTH 20	WQ0227	1996	88.2%	Nonimpaired	79	Fair
Ochre R.	PTH 20	WQ0227	1997	58.8%	Slight	83	Good
Ochre R.	PTH 20	WQ0227	1998	105.9%	Nonimpaired	84	Good
Pine R.	PTH 20	WQ0233	1995	70.6%	Nonimpaired	77	Fair*
Pine R.	PTH 20	WQ0233	1996	58.8%	Slight	83	Good*
Pine R.	PTH 20	WQ0233	1997	58.8%	Slight	86	Good*
Pine R.	PTH 20	WQ0233	1998	47.1%	Moderate	85	Good*

Table 4. Comparison of macroinvertebrate biological condition scores to Canadian Water Quality Index based on water chemistry, physical and bacteriological data (continued).

Stream	Location	Site	Year	Biological Score % of Highest Score	Biological Condition Relative Impairment	CWQI Score	Canadian Water Quality Index Rating[1]
Swan R.	PR 268	WQ0244	1995	52.9%	Moderate-Slight	65	Fair*
Swan R.	PR 268	WQ0244	1996	41.2%	Moderate	81	Good*
Swan R.	PR 268	WQ0244	1997	94.1%	Nonimpaired	69	Fair*
Swan R.	PR 268	WQ0244	1998	94.1%	Nonimpaired	71	Fair*
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1995	29.4%	Moderate	86	Good
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1996	41.2%	Moderate	86	Good
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1997	35.3%	Moderate	89	Good
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1998	41.2%	Moderate	90	Good
Valley R.	PTH 20	WQ0250	1995	94.1%	Nonimpaired	85	Good*
Valley R.	PTH 20	WQ0250	1996	47.1%	Moderate	41	Poor*
Valley R.	PTH 20	WQ0250	1997	88.2%	Nonimpaired	83	Good*
Valley R.	PTH 20	WQ0250	1998	70.6%	Slight	84	Good*
Vermilion R.	PTH 20	WQ0252	1995	100.0%	Nonimpaired	61	Fair*
Vermilion R.	PTH 20	WQ0252	1996	35.3%	Moderate	78	Fair*
Vermilion R.	PTH 20	WQ0252	1997	64.7%	Slight	63	Fair*
Vermilion R.	PTH 20	WQ0252	1998	52.9%	Moderate-Slight	72	Fair*
Edwards Cr.	PTH 5/10	WQ0253	1995	88.2%	Nonimpaired	65	Fair*
Edwards Cr.	PTH 5/10	WQ0253	1996	58.8%	Slight	73	Fair*
Edwards Cr.	PTH 5/10	WQ0253	1997	94.1%	Nonimpaired	65	Fair*
Edwards Cr.	PTH 5/10	WQ0253	1998	70.6%	Slight	75	Fair*
Wilson R.	PTH 20	WQ0255	1995	88.2%	Nonimpaired	77	Fair*
Wilson R.	PTH 20	WQ0255	1996	76.5%	Slight	84	Good*
Wilson R.	PTH 20	WQ0255	1997	47.1%	Moderate	75	Fair*
Wilson R.	PTH 20	WQ0255	1998	94.1%	Nonimpaired	77	Fair*
Woody R.	PR 268	WQ0259	1995	64.7%	Slight	84	Good*
Woody R.	PR 268	WQ0259	1996	11.8%	Severe	42	Poor*
Woody R.	PR 268	WQ0259	1997	105.9%	Nonimpaired	69	Fair*
Woody R.	PR 268	WQ0259	1998	76.5%	Slight	82	Good*
Souris R.	Treesbank	WQ0350	1995	88.2%	Nonimpaired	68	Fair
Souris R.	Treesbank	WQ0350	1996	58.8%	Slight	64	Fair
Souris R.	Treesbank	WQ0350	1997	111.8%	Nonimpaired	74	Fair
Souris R.	Treesbank	WQ0350	1998	88.2%	Nonimpaired	60	Fair
Marsh R.	PR 303	WQ0365	1995	58.8%	Slight	51	Marginal*
Marsh R.	PR 303	WQ0365	1996	41.2%	Moderate	48	Marginal*
Marsh R.	PR 303	WQ0365	1997	47.1%	Moderate	48	Marginal*
Marsh R.	PR 303	WQ0365	1998	47.1%	Moderate	57	Marginal*
Cypress R.	NE of town	WQ0398	1995	88.2%	Nonimpaired	81	Good*
Cypress R.	NE of town	WQ0398	1996	76.5%	Slight	83	Good*
Cypress R.	NE of town	WQ0398	1997	88.2%	Nonimpaired	70	Fair*
Cypress R.	NE of town	WQ0398	1998	88.2%	Nonimpaired	54	Marginal*
Waterhen R.	Waterhen	WQ0561	1995	47.1%	Moderate	97	Excellent*
Waterhen R.	Waterhen	WQ0561	1996	76.5%	Slight	94	Excellent*
Waterhen R.	Waterhen	WQ0561	1997	70.6%	Slight	97	Excellent*
Waterhen R.	Waterhen	WQ0561	1998	64.7%	Slight	97	Excellent*
Cooks Cr.	Boundary Rd.	WQ0643	1996	70.6%	Slight	63	Fair
Cooks Cr.	Boundary Rd.	WQ0643	1997	82.4%	Slight-Nonimpaired	74	Fair
Cooks Cr.	Boundary Rd.	WQ0643	1998	82.4%	Slight-Nonimpaired	79	Fair
Cooks Cr.	S of Millbrook	WQ0644	1996	52.9%	Moderate-Slight	83	Good
Cooks Cr.	S of Millbrook	WQ0644	1997	47.1%	Moderate	73	Fair
Pipestone Cr. Diversion	Boundary	WQ1242	1996	82.4%	Slight-Nonimpaired	73	Fair
Pipestone Cr. Diversion	Boundary	WQ1242	1997	70.6%	Slight	74	Fair
Pipestone Cr. Diversion	Boundary	WQ1242	1998	58.8%	Slight	74	Fair

* Less than five water samples may cause over or under estimation of CWQI

1. CWQI category ranges: 95-100 Excellent; 80-94 Good; 60-79 Fair; 45-59 Marginal; and 0-44 Poor.

between two categories of relative biological condition, there were some exceptions. Generally, the biological condition categories ranged from moderate impairment to non-impairment. Severe impairment ratings were observed on one occasion each for the Woody and Sclater Rivers and severe to moderate impairment was observed on one occasion for the La Salle River (Tables 3 and 4).

The CWQI ratings for various streams generally varied from fair to good. There were four excellent ratings for the Waterhen River and one excellent rating for each of the Brokenhead and Sclater Rivers (Table 4). There were four marginal ratings observed for the Marsh River and one marginal rating observed for each of the Vermilion and Cypress rivers. There was one poor rating observed for each of the Seine, Valley and Woody rivers. Some of the CWQI calculations were based on only three or four water samples per year. Therefore, some of the CWQI ratings may either over or underestimate the water quality for any given year.

Boyne River

The Boyne River (site WQ0029) biological condition indicated moderate to slight impairment in 1995 and 1998 with only slight impairment in 1996 and 1997 (Table 3). This was relatively comparable to the CWQI water quality rating that was generally in the upper range of fair with a good rating in 1996 (Table 4). Although the two ratings appeared to be not particularly comparable in 1997, the biological condition was in the low end of the range for slight impairment and the CWQI rating was nearly in the good water quality range. Also, water sampling was only conducted on four occasions per year rather than the recommended five or more samples per year. Therefore, it is possible that the CWQI rating may slightly underestimate water quality.

Brokenhead River

The Brokenhead River (site WQ0038) biological condition consistently indicated moderate impairment except for only slight impairment in 1998 (Table 3). The CWQI water quality rating was generally good and only excellent in 1995. Except for 1998 the biological condition appeared to be slightly lower than expected considering the water quality. It is possible that the CWQI rating slightly overestimates the water quality conditions, particularly in 1995, with only four water samples collected per year (Table 4). Also, from 1995 through 1997, invertebrate sampling was carried out in the cattails on the south shore where footing was awkward and some potentially available taxa may not have been collected. Biological condition may have been underestimated for these years. The biological condition improved in 1998 when invertebrate sampling was carried out along the north shore where sampling conditions were better since the sand and gravel bottom provided solid footing.

La Salle River

The La Salle River (site WQ0068) biological condition indicated moderate impairment from 1995 through 1997 with severe to moderate impairment in 1998 (Table 3). The CWQI water quality rating was consistently fair (Table 4). The water quality ratings for the CWQI are probably reasonably accurate since water samples were collected on 8 to 16 occasions in per year. Except for 1998 the biological condition was comparable to the water quality rating. Macroinvertebrates could only be collected in the near shore area since the centre of the river is too deep for wading and sampling in the clay and muck substrate was awkward. Sampling difficulty would have contributed to the low numbers of organisms collected in 1995, 1996, and 1998 with pooled samples of 48, 79, and 44 organisms, respectively, and may have affected biological condition ratings (Table 2). However, the moderate impact rating in 1997 is likely to be relatively accurate since some 225

macroinvertebrates were included in the pooled sample. The severe to moderate impact indicated by the macroinvertebrate community condition at this site on August 19, 1998 could be due to the particularly small pooled sample size but the 1998 biotic condition may also reflect changes in the environment. The recent construction of a new bridge and installation of riprap at the PTH 75 bridge immediately downstream of the site in 1998 may have adversely affected the macroinvertebrate community. Despite the small macroinvertebrate sample in 1998, this may still be a relatively accurate assessment of biotic condition. In any case it appeared advisable to find a new location to sample macroinvertebrates. In 1999 macroinvertebrates were collected further upstream, immediately below the dam at La Barriere Park, where sampling ease and productivity increased considerably.

Little Saskatchewan River

The Little Saskatchewan River (site WQ0105) biological condition indicated slight impairment in 1995 and 1998, non-impairment in 1996, and moderate impairment in 1998 (Table 4). This site was particularly productive with pooled samples of 3121 to 6988 macroinvertebrates per year (Table 2). The CWQI ratings were good in 1995, 1997, and 1998 and fair in 1996. Although these ratings are relatively comparable for 1995 and 1998, the CWQI rating may overestimate the water quality in 1997 and underestimate water quality in 1996, when only four water samples were collected per year (Table 4).

Rat River

The Rat River (site WQ0131) biological condition consistently indicated non-impairment (Table 3). The CWQI ratings indicated good water quality in 1995, 1996, and 1998 but only fair water quality in 1997. The CWQI may have slightly underestimated the water quality, particularly in 1997, with only four water samples collected per year (Table 4). However, it appears that the macroinvertebrate community at this location may recover relatively quickly from the impact of water quality that may be degraded on occasion. The recommended objective for cool water aquatic life is a 47% or greater dissolved oxygen saturation; dissolved oxygen saturation levels dropped below 47% once or twice per year except in 1998. Elevated fecal coliform bacteria counts were frequently associated with low oxygen concentrations and may be associated with some problems with local sewage treatment. However, total phosphorus concentrations were not unusually high for a prairie stream. Habitat at the sampling site is also generally good with riffles and shallow pools. There is probably a relatively quick recovery from low oxygen levels.

Roseau River

The Roseau River (site WQ0153) biological condition indicated slight impairment in 1995 and non-impairment from 1996 through 1998 (Table 3). The CWQI ratings were fair in 1996 and 1998 in good in 1995 and 1997 (Table 4). The biological condition and water quality rating in 1995 were consistent. In the other cases, the CWQI may have slightly underestimated the water quality when only four water samples were collected per year. However, invertebrates could only be collected in the near shore area at this site since the centre of the river is too deep for wading. Also, footing in the near shore area was a problem due to the presence of large boulders. It is possible that some less sensitive taxa that may have been present at greater depth were not collected and this may have artificially improved relative biological condition from 1996 through 1998. However, the only macroinvertebrate pooled sample, small enough to potentially affect calculations, was that collected in 1996 (56 organisms). The biological condition was likely over estimated particularly since the CWQI only indicated fair water quality (Table 2). Also, the occurrence of the apparently unimpaired macroinvertebrate communities in 1997 and 1998 may reflect advantageous conditions relating to the habitat for the macroinvertebrates that may have occurred due to effects of the flood in the spring of 1997.

Seine River

The Seine River (site WQ0166) biological condition consistently indicated moderate impairment except for slight impairment in 1995. Except for 1995, similar conditions were indicated by the CWQI ratings of fair in 1996 and 1998 in the low end of the range for good in 1997 (Table 3). With the possible exception of 1997 when only four water samples were collected, the remainder of the CWQI ratings should have been relatively accurate with 11 to 30 water samples collected per year. However, poor CWQI rating in 1995 may have underestimated water quality due to one particularly high value for MCPA (73 µg/L) this was a large excursion from the objective of 0.025 µg/L. Sufficient numbers of macroinvertebrates were collected each year to provide relatively accurate estimates of biotic condition. However, in 1995 and 1998 the macroinvertebrate community appeared to be in a better condition than expected considering the water quality indices.

Whitemud River

The Whitemud River (site WQ0197) biological condition consistently indicated non-impairment except for slight impairment to nonimparment in 1998 (Table 3). Similar conditions were indicated by the CWQI ratings of good from 1995 through 1997 and fair in 1998 (Table 4). The CWQI ratings were probably relatively accurate since, except for 1995 when only four water samples were collected, there were eight water samples collected per year from 1996 through 1998. Macroinvertebrate condition appeared slightly better than expected with respect to water quality, probably due to the quality and variety of habitat; a significant artificial riffle zone sampled downstream of Westbourne.

North Duck River

The North Duck River (site WQ0217) biological condition indicated a slight impairment in 1995 1998, slight to moderate impairment in 1997, and moderate impairment in 1996 (Table 3). The CWQI indicated good water quality for 1995, 1996, and 1998 and fair water quality in 1997 (Table 4). The biological condition and the CWQI water quality estimates for 1995 and 1998 were relatively consistent. However, since only 63 organisms were collected from the site in 1996 it is possible that the moderate impairment indicated for that year slightly underestimated the relative condition of the macroinvertebrate community. The CWQI may have slightly overestimated the water quality particularly in 1996 and 1998 since only three water samples were collected per year.

Sclater River

The Sclater River (site WQ0220) biological condition indicated moderate impairment in 1995, nonimparment in 1996, slight impairment in 1997, and severe impairment in 1998 (Table 3). Since these biological condition estimates were based on pooled sample sizes ranging from 142 to 436 organisms (Table 2 and 3) it is likely that they are relatively accurate. The CWQI may have slightly overestimated the water quality particularly in 1995 and 1998, since only three water samples were collected per year (Table 4). However, the estimates for biological condition and CWQI water quality were consistent for 1996 and 1997, where the CWQI rating for 1996, and 1997 were excellent and good, respectively. This was also true for 1995 when the water quality rating was in the low end of the range for good water quality. However, the CWQI rating for 1998 was good and was widely divergent from the biological condition which indicated severe impairment. On October 11, 1995 the total dissolved solids were 2800 mg/L. Normally total dissolved solids are under 500 mg/L. This may account for a minor impact on the invertebrates in 1995. Total dissolved solids ranged from 340 to 410 mg/L in 1998, well within the normal range in this stream. However, on July 7, 1998 a low dissolved oxygen level of 3.4 mg/L (38.1 % saturation) occurred in water samples from this site. It is possible that a prolonged period of low oxygen could have

eliminated some of the macroinvertebrate taxa. The recommended objective for cool water aquatic life is a 47% or greater dissolved oxygen saturation. There was definite evidence of change in community structure. Ephemeroptera were predominant at 53 % of the macroinvertebrate communities in each of 1996 and 1997 when the biological conditions indicated non-impairment and slight impairment (Appendix 2). In 1998, when the impact was severe, there were no Ephemeroptera in the pooled macroinvertebrate sample and Odonata predominated at 42% (Appendix 1). In 1995 when the impact was moderate, there was also a predominance of Odonata at 30% and only one Ephemeropteran. However, the 1995 pooled sample included a considerable number of taxa, mainly Chironomidae, not observed in the 1998 pooled sample.

Fishing River

The Fishing River (site WQ0223) biological condition indicated non-impairment in 1998, slight impairment in 1997, moderate to slight impairment in 1995, and moderate impairment in 1996 (Table 3). The CWQI ratings for water quality were good from 1996 through 1998, approaching excellent in 1998, and in the upper range of fair in 1995. The CWQI may have slightly underestimated the water quality since only three water samples were collected per year (Table 4). However, with the possible exception of 1996 the biological condition and the water quality estimates were relatively similar to one another. It is also possible that the biological condition rating for 1996 was slightly underestimated since there were only 42 macroinvertebrates in the pooled sample (Table 2). The pooled sample of macroinvertebrates in 1997 included 82 organisms; this was probably sufficient to provide a reasonable estimate of biological condition.

Mossy River

The Mossy River (site WQ0226) biological condition indicated non-impairment in 1995 and 1998, slight impairment in 1997, and moderate to slight impairment in 1996 (Table 3). The CWQI ratings for water quality were at the high end of the fair range in 1997 and good in 1995, 1996, and 1998. These two estimates are relatively consistent with one another in 1995 while the biological condition was better than might be expected relative to water quality in 1997 and 1998. Only three water samples were collected per year therefore the CWQI may have slightly underestimated the water quality at this site during those years (Table 4). Habitat or other conditions may have been particularly good in 1997 and 1998 and may have modified the effect of some degradation in water quality.

Ochre River

The Ochre River (site WQ0227) biological condition indicated non-impairment in 1996 and 1998, slight impairment to non-impairment in 1995, and slight impairment in 1997 (Table 3). The biological condition estimate for 1997 was probably most accurate since this was derived from 268 organisms, the largest pooled sample of macroinvertebrates at this site (Table 2). Biological condition and water quality estimates were most consistent in 1997 while biological condition appeared to be better than the potential indicated by water quality during the other years. The CWQI ratings for water quality were good in 1997 and 1998 and in the upper range of fair in 1995 and 1996 (Table 4). The CWQI ratings should have been relatively accurate since they were based on between 7 and 11 water samples collected per year. There were only 64 macroinvertebrates in the pooled sample collected in 1995; it is possible that biological condition was over estimated that year (Table 2). In 1996 there were 99 macroinvertebrates in the pooled samples and this was probably close enough to the recommended 100 organisms to provide a reasonable if slightly high estimate of biological condition. Likewise, the 1998 sample of 178 organisms should have provided a relatively good estimate of biological condition. It is possible that habitat, flow regimes or other factors may have been advantageous to macroinvertebrate communities at this location

Pine River

The Pine River (site WQ0233) biological condition indicated non-impairment in 1995, slight impairment in 1996 and 1997, and moderate impairment 1998 (Table 3). The CWQI ratings for water quality were good from 1996 through 1998, in the high end of the fair range in 1995 (Table 4). The biological condition and water quality estimates for 1996 and 1997 were relatively consistent. Only three water samples were collected per year and the CWQI may have slightly underestimated the water quality at this site in 1995 and overestimated the water quality in 1998. Macroinvertebrates could only be collected in the near-shore area since the centre of the river was too deep for wading. Sufficient numbers of organisms were collected each year such that the biological condition ratings for these years are probably relatively accurate (Table 2). Since this site is located at the mouth of the river where it discharges into Lake Winnipegosis, it is possible that wind tides from the lake may affect macroinvertebrate communities. Also, specific conductivity at this site was variable ranging from 306 to 1370 µS/cm; it is possible that saltwater springs upstream of the site may have influenced macroinvertebrate communities on occasion. Such potential influences on macroinvertebrate communities would have been positive in 1995 and negative in 1998.

Swan River

The Swan River (site WQ0244) biological condition indicated non-impairment in 1997 and 1998, moderate to slight impairment in 1995 and moderate impairment in 1996 (Table 3). The CWQI ratings for water quality were good in 1996, and fair in 1995, 1997 and 1998 (Table 4). The biological condition and water quality ratings were consistent in 1995 but not in other years. Only three water samples were collected per year and the CWQI may have overestimated water quality at this site in 1996 and underestimated the water quality at this site in 1997 and 1998. In 1995 and 1996 the pooled samples of macroinvertebrates were only 64 and 41 organisms, respectively. It is possible that the biological condition likely was underestimated in 1996 (Table 2). However, in 1997 and 1998 the numbers of macroinvertebrates in the pooled samples were 152 and 128 organisms, respectively which should have been sufficient to provide a reasonably accurate estimate of biological condition. The current velocity at the time of sampling in 1996 was relatively high at approximately 0.61 m/s; it is possible that some of the relatively intolerant taxa may have been washed out of the sand substrate (Table 2). However, during the other three years, current velocity at the time of sampling was relatively low. It is possible that the sand substrate in relatively shallow water at this site was advantageous to the establishment of relatively intolerant taxa that survived in spite of degraded water quality.

Turtle River

The Turtle River (site WQ0245) biological condition indicated moderate impairment from 1995 through 1998 (Table 3). The CWQI ratings for water quality was good from 1995 through 1998 (Table 4). The CWQI ratings should have been relatively accurate since they were based on between 7 and 11 water samples collected per year. Collection of organisms in midstream was difficult in deeper locations but sufficient numbers of macroinvertebrates were collected each year such that the estimates of the biological condition should be relatively accurate. It is likely that environmental factors other than water chemistry were negatively impacting the macroinvertebrate community to some degree.

Valley River

The Valley River (site WQ0250) biological condition indicated non-impairment in 1995 and 1997, slight impairment in 1998, and moderate impairment in 1996 (Table 3). The CWQI ratings for water quality were good in 1995, 1997, and 1998 and poor in 1966 (Table 4). The biological condition and CWQI ratings were consistent in 1998 but biological condition was better than might be expected in 1995, 1996, and 1967. There were relatively

low numbers of macroinvertebrates in pooled samples in 1996 and 1998 (65 and 73 organisms, respectively), thus overestimating the biological condition for 1996 (Table 2). There were sufficient numbers of organisms in the 1995 and 1997 macroinvertebrate samples that biological condition estimates should have been reasonable. The CWQI may have slightly underestimated the water quality conditions in 1995, 1996, and 1997, since only three water samples were collected per year. Biological condition in 1995 and 1997 may also have been positively enhanced by environmental factors related to habitat and flow regime. On August 26, 1996, macroinvertebrate sampling was restricted to the shoreline area due high current velocities of approximately 1.1 m/s and may have affected the assessment of the invertebrate community.

Vermilion River

The Vermilion River (site WQ0252) biological condition indicated non-impairment in 1995, moderate impairment in 1996, slight impairment in 1997, and moderate to slight impairment in 1998 (Table 3). Sufficient numbers of macroinvertebrates were collected each year that pooled samples probably provided fairly accurate estimates of biological condition. This was the case even on September 24, 1998 when pooled samples still yielded 126 macroinvertebrates, even though the current velocity was fairly high at approximately 1.0 m/s and sampling was restricted to the shoreline (Table 2). The CWQI rating for water quality was fair throughout all four years (Table 4). The CWQI may have slightly underestimated the water quality conditions, particularly in 1995, since only three water samples were collected per year. The moderate and moderate to slight impacts on the macroinvertebrate communities observed in 1996 and 1998 were consistent with CWQI ratings. However, the macroinvertebrate communities in 1995 and 1997 appeared to be thriving despite somewhat degraded water quality. These communities showed non-impaired and slightly impaired biological condition with relatively high proportions of Ephemeroptera at 80 and 64% respectively in 1995 (Table 4 and Appendix 1). It is likely that the quality of the habitat, mainly shale and gravel varying from shallow riffles to deep pools, accounted to some degree for relatively healthy macroinvertebrate communities (Table 2).

Edwards Creek

The Edwards Creek (site WQ0253) biological condition indicated non-impairment in 1995 and 1997, and slight impairment in 1996 and 1998 (Table 3). The CWQI ratings for water quality were fair from 1995 through 1998 (Table 4). The CWQI may have slightly underestimated the water quality conditions, particularly in 1995 and 1997, since only three water samples were collected per year. Although there appeared to be reasonably large numbers of pooled macroinvertebrates from 1995 through 1997, the biological condition may have been slightly overestimated in 1998 when there were only 66 organisms in the pooled sample (Table 2). Although the habitat at this location is in large part man-made, it consists of riffles and shallow pools with shale, gravel, and rock with some upstream concrete structures and the water is generally well oxygenated. It is likely that the quality of the habitat accounts to some degree for the relatively healthy macroinvertebrate communities (Table 2).

Wilson River

The Wilson River (site WQ0255) biological condition indicated non-impairment in 1995 and 1998, slight impairment in 1996, and moderate impairment in 1998. These were relatively consistent with CWQI ratings. The CWQI ratings for water quality were good in 1996 and in the upper end of the fair range in 1995, 1997, and 1998 (Table 4). The CWQI may have slightly underestimated the water quality conditions, particularly in 1995 and 1998, since only three water samples were collected per year. The biological condition and water quality ratings were relatively consistent in 1996 and 1997 but in 1995 and 1998, the

macroinvertebrate community appeared to be relatively healthy despite somewhat degraded water quality.

Woody River

The Woody River (WQ0259) biological condition indicated slight impairment in 1997 and 1998, moderate impairment in 1995, and severe impairment in 1996 (Table 3). The CWQI ratings for water quality were good in 1995 and 1998, fair in 1997 and poor in 1996 (Table 4). The biological and CWQI ratings were relatively consistent except for 1997. The CWQI may have slightly underestimated the water quality conditions, particularly in 1997, since only three water samples were collected per year. The severe impact on the macroinvertebrate community in 1996 (with only 42 organisms collected in five samples on August 27, 1996) was also probably due in part to high current velocities (approximately 1.25 m/s) (Table 2). It is likely that many of the less tolerant taxa were washed out of the sand substrate in 1996. The biological condition indicating non-impairment in 1997 was probably relatively accurate since over 1000 organisms were included in the pooled sample. Despite relatively degraded water quality conditions, it appears that the macroinvertebrate community was particularly healthy since the some 69% of the macroinvertebrates were Ephemeroptera in 1997.

Souris River

The Souris River (WQ0365) biological condition indicated non-impairment in 1995, 1997, and 1998, and slight impairment in 1996. Since between 244 and 667 organisms were included in pooled macroinvertebrate samples from each year, biological condition estimates would have been relatively accurate (Table2). The CWQI ratings were fair from 1995 through 1998 (Table 4). The CWQI ratings should also have been relatively accurate since 12 water samples were collected each year. A large proportion of the excursions from water quality guidelines and objectives were related to total phosphorus which would tend to increase plant growth and thus provide a potential food source for some macroinvertebrates. Dissolved oxygen levels were generally good except occasionally in the winter. It appears that organisms in this mainly shale and gravel substrate were fairly well adapted to relatively poor water quality conditions.

Marsh River

The Marsh River (WQ0350) biological condition indicated slight impairment in 1995 and moderate impairment from 1996 through 1998. Macroinvertebrate pooled sample sizes ranged from 132 and 3036 organisms; there should have been sufficient numbers of organisms each year to provide reasonably accurate biological condition estimates (Table 2). The CWQI quality ratings were marginal throughout all years (Table 4). The biological condition and CWQI ratings were relatively consistent for 1996 through 1998. However, the slight impact observed for the macroinvertebrate community and the marginal water quality rating observed for 1995 diverged considerably. The CWQI may have slightly underestimated the water quality conditions, particularly for 1995, since only four water samples were collected per year. However, the water quality at this site was quite variable with respect to total dissolved solids. Also, there were frequently anoxic conditions in the winter probably due to decay of plant material. Phosphorus levels were generally high and this would have adversely affected the CWQI ratings but would not likely impact the biota in a negative way. However, high nutrient levels may have contributed to plant growth and subsequent plant decay leading to oxygen depletion. During the flood of 1997, the area was inundated with Red River water. The headwaters of the Marsh River are near the Red River. Even during more normal years the Marsh River may receive floodwater from the Red River and this appeared to be the case in April of 1999. It is possible that occasional flushing with Red River water improved conditions for biota.

Cypress River

The Cypress River (WQ0398) biological condition indicated non-impairment in 1995, 1997, and 1998 (Table 3). Although macroinvertebrates sampled in this reach of the stream may be disturbed to some degree since it is located in a cattle pasture, the macroinvertebrate communities appeared to be relatively healthy. The habitat consists of a wide range of potential substrate that is predominantly shale and gravel with riffles and shallow pools (Table 2). There were sufficient numbers of macroinvertebrates collected each year, with pooled samples ranging from 272 to 795 organisms, such that the biological condition estimates should have been relatively accurate (Table 2). The CWQI quality ratings were good in 1995 and 1996, fair in 1997, and in the high end of the marginal range in 1998 (Table 4). Similar conditions were indicated by the CWQI and biological condition ratings in 1995 and 1996. However, the CWQI may have slightly underestimated the water quality conditions, particularly in 1997 and 1998, since only three water samples were collected per year. During spring runoff on April 8, 1998, total phosphorus and total suspended solids were unusually elevated at 1.06 mg/L and 640 mg/L, respectively. Such unusually high excursions from guidelines and objectives for water quality (Appendix 5) would have been responsible for decreasing the CWQI rating from fair to marginal in 1998 even though the remaining water quality indicators for that year were relatively normal. As with many other prairie streams, the total phosphorus was relatively high in general and would have contributed to the growth of *Cladophora* sp. and other plants that would provide a food source for some macroinvertebrates.

Waterhen River

The Waterhen River (WQ0561) biological condition indicated slight impairment from 1996 through 1998 and moderate impairment in 1995 (Table 3). The CWQI quality ratings were excellent from 1995 through 1998 (Table 4). However, the CWQI may have slightly overestimated the water quality conditions, since only three water samples were collected per year. The numbers of macroinvertebrates collected each year were quite variable ranging from 153 to 2368 organisms in pooled samples. However, these numbers should have provided reasonably good estimates of biological condition. The biological condition ratings improved with a sampling location change in 1996. Biological condition and the CWQI ratings were relatively consistent for 1996 through 1998. However, it is still possible that some of the more sensitive taxa that may have been established further offshore were not collected and this could have artificially reduced biological condition estimates in all years. Because the river is wide, deep, and swift and macroinvertebrate sampling was restricted to the near-shore area. Macroinvertebrate sampling at this site was carried-out off the east shore of the river in 1995 but moved to the west shore of the river in 1996. The east shore was difficult to sample due to poor footing and a tendency to back-flood into the near-shore vegetation. Although current velocities were considerably greater on the west shore, footing in the cobble and rock substrate was better (Table 2).

Cooks Creek

The Cooks Creek macroinvertebrates were monitored at two sites in 1996 and 1997 and at one site in 1998. The downstream site (WQ0643) is located in a natural stream channel while the upstream site (WQ0644) is in a straight channelized portion of the creek. At the downstream site (WQ0643), located at the boundary of the rural municipalities of Springfield and St. Clements, biological condition indicated slight impairment to non-impairment in 1997 and 1998, and slight impairment in 1996 (Table 3). At the upstream site (WQ0644) located south of Millbrook the biological condition indicated slight to moderate impairment in 1996 and moderate impairment in 1997. At both sites there were sufficient numbers of macroinvertebrates collected each year such that the biological condition estimates should have been reasonable. In 1998 macroinvertebrate sampling was discontinued

at the upstream site since channelization provided a relatively unnatural bottom consisting mainly of clay nodules. On some occasions the stream virtually dries up at this site and it is frozen to the bottom in the winter (Table 2). The CWQI ratings at the downstream site (WQ0643) were fair from 1996 through 1998 (Table 4). The CWQI ratings at the upstream site (WQ0644) was good in 1996 and fair in 1997. Sufficient water sampling was carried out at each site, with from 6 to 11 water samples each year, such that the CWQI estimates of water quality should have been relatively accurate. The biological condition and the CWQI ratings for the upstream site were relatively consistent. The macroinvertebrate community in the relatively natural habitat at the downstream Cooks Creek site appeared to be more resilient and showed a somewhat better biological condition than might be expected in comparison to the water quality ratings.

Pipestone Creek Diversion

The Pipestone Creek Diversion site (WQ1242) is located at the boundary of the rural municipalities of Pipestone and Sifton. This is located in an artificial channel but has a well-established growth of cattail and other emergent and submergent aquatic plants. The biological condition indicated slight impairment to non-impairment in 1996 and slight impairment in 1997 and 1998 (Table 3). The CWQI quality ratings were good in 1997 and 1998, and at the high end of the fair range in 1996. The CWQI ratings should also have been relatively accurate since between 5 and 11 water samples were collected each year (Table 4). The macroinvertebrate community appeared to be in better condition than expected considering the water quality, particularly in 1996. Macroinvertebrates are difficult to sample at this site since the bottom consists of clay and muck with decaying organic material and the centre of the channel is too deep for wading. It is possible that some Oligochaeta and other relatively tolerant organisms may not have been sampled in the soft sediments at greater depth resulting in artificially improved biological condition.

Alternative Bioassessment Approaches

The macroinvertebrate bioassessment approach used in this assessment is the one advocated for Rapid Bioassessment Protocol III (Plafkin *et al.* 1989). This method for bioassessment has been commonly used in North America. However, there are other bioassessment techniques that have potential. One of these is a variation on the British BMWP (Armitage *et al.* 1983) as used by Javier Alba-Tercedor (Zamora-Munoz and Alba-Tercedor 1996). Javier Alba-Tercedor has had good success with this method for assessments on some Manitoba rivers according to Cobb (1999). This method of assessment would require a change in macroinvertebrate collection methods but may be more appropriate than the methods used in this study. Rather than attempt to collect several m^2 samples with kick nets the object would be to collect a composite sample from all potential habitats at each site and to continue to sample until it appears that there are no new taxa to be gained from subsequent sampling. Also, this method may be used as a truly rapid bioassessment by trained personnel since it is based on cumulative scores for families and could potentially be done on site provided the sampling team has sufficient expertise. Each identified family observed at the site is assigned a score with the highest scores for the most intolerant organisms and the lowest scores for most tolerant organisms. The sum of scores for each family present can be rated on a scale from very critical to good. Laboratory analyses to genus and species levels is costly as well as time consuming and in some cases organisms cannot be positively identified to genus and species level in any case. Also, the use of multiple metrics in the Rapid Bioassessment Protocol III requires a considerable amount of work to assign of tolerance values for various taxa, to conduct various statistical manipulations, and to compare each site to a reference site; this is not always practical.

Another potential assessment method is the BioMAP (Biological Monitoring and Assessment Program) used by R. W. Griffiths (2000) for assessments in Ontario streams.

However, there appears to be a preference for the use of Surber samplers rather than kick nets in order to obtain truly quantitative rather than qualitative samples. The use of Surber samplers at most of the Manitoba sampling sites is impractical due to excessive stream depth. Also there appears to be some uncertainty as to the efficacy or at least a reasonable rationale for preference of this bioassessment technique over others (Barton and Kilgour 2000).

Conclusions

- Most of the streams assessed for biotic condition ranged from unimpaired to moderately impacted by water quality and other environmental factors. In many cases the condition of the macroinvertebrate communities were consistent with water quality. However, in other situations macroinvertebrate communities appeared to be well adapted and were able thrive in less than optimal water quality conditions. There were also other situations where environmental factors other than water quality appear to have been detrimental to the health of the macroinvertebrate communities.
- In some cases it appears that earlier flooding during the year may have been beneficial to macroinvertebrate communities as observed for the Roseau River in August of 1997.
- Recent flooding or freshets tend to scour substrates and invertebrates and can be temporarily detrimental to macroinvertebrate communities as appears to have occurred on the Woody River in 1996. This is mainly due to the reduction of numbers and variety of organisms at time of sampling. Examination of macroinvertebrate community condition in other years is necessary in order to properly assess the health of the stream.
- Continued annual monitoring is recommended in order to determine trends in macroinvertebrate community condition and to avoid the potential for incorrect assumptions based on once only sampling.
- High current velocity, excessive sampling depth, or difficult footing in mud or large boulders is likely to hinder the collection of adequate macroinvertebrate sample sizes and some important taxa may not be adequately represented. In some cases it may be appropriate to move sampling locations in order to improve collection of macroinvertebrate samples.
- It may be of value to experiment with other bioassessment techniques that are less time consuming. One of these potential alternatives is a Spanish variation of the British BMWP method.

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Appendices 1 through 5

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998.

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon 1995	1996	1997	1998	% Order or Subclass 1995	1996	1997	1998
WQ0029	**Boyne River at Carman upstream of water treatment plant, total of 5 samples per site per year*.**										
WQ0029	Arachnoidae	Hydracarina	Hydracarina unidentified	3				2.01%	0.00%	0.00%	0.00%
WQ0029	Crustacea	Amphipoda	*Gammarus sp.*	1							
WQ0029	Crustacea	Amphipoda	*Hyalella azteca*	21	75	93	2	14.77%	22.39%	21.43%	1.98%
WQ0029	Crustacea	Decapoda	*Orconectes immunis*	2							
WQ0029	Crustacea	Decapoda	*Orconectes virilis*		4						
WQ0029	Crustacea	Decapoda	*Orconectes sp.*			3		1.34%	1.19%	0.69%	0.00%
WQ0029	Insecta	Coleoptera	*Dubiraphia sp.*		1	29	5				
WQ0029	Insecta	Coleoptera	*Haliplus borealis*			2					
WQ0029	Insecta	Coleoptera	*Haliplus immaculicollis*	1		4					
WQ0029	Insecta	Coleoptera	*Haliplus sp.*		1		7				
WQ0029	Insecta	Coleoptera	*Laccophilus maculosus*			1					
WQ0029	Insecta	Coleoptera	*Peltodytes edentulus*	2		4		2.01%	0.60%	9.22%	11.88%
WQ0029	Insecta	Diptera Chironomidae.	Chironomidae unidentified			2	3				
WQ0029	Insecta	Diptera Chironomidae.	*Ablabesmyia sp.*		7	4					
WQ0029	Insecta	Diptera Chironomidae	*Chironomus anthracinus*	1							
WQ0029	Insecta	Diptera Chironomidae	*Chironomus sp.*		81	3	5				
WQ0029	Insecta	Diptera Chironomidae	*Chironomus thummi*	13							
WQ0029	Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*			3					
WQ0029	Insecta	Diptera Chironomidae	*Cricotopus sp.*		1	3					
WQ0029	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*			1					
WQ0029	Insecta	Diptera Chironomidae	*Cryptotendipes sp.*			3	2				
WQ0029	Insecta	Diptera Chironomidae	*Dicrotendipes sp.*	1							
WQ0029	Insecta	Diptera Chironomidae	*Endochironomus sp.*	1							
WQ0029	Insecta	Diptera Chironomidae	*Glyptotendipes sp.*		2	4	3				
WQ0029	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*	6	27	11	16				
WQ0029	Insecta	Diptera Chironomidae	*Polypedilium sp.*			10					
WQ0029	Insecta	Diptera Chironomidae	*Procladius sp.*	8	4	1	2				
WQ0029	Insecta	Diptera Chironomidae	*Robackia sp.*		2						
WQ0029	Insecta	Diptera Chironomidae	*Stictochironomus sp.*				8				
WQ0029	Insecta	Diptera Chironomidae	*Tanytarsus sp.*		5	31	1	20.13%	38.51%	17.51%	39.60%
WQ0029	Insecta	Diptera Miscelaneous	Diptera Misc. unidentified		1						
WQ0029	Insecta	Diptera Miscelaneous	*Palpomyia sp.*	1	1	2	1	0.67%	0.60%	0.46%	0.99%
WQ0029	Insecta	Ephemeroptera	Beatedae unidentified			1					
WQ0029	Insecta	Ephemeroptera	*Baetis sp.*			1					
WQ0029	Insecta	Ephemeroptera	*Caenis sp.*		5	1					
WQ0029	Insecta	Ephemeroptera	*Callibaetis sp.*	8		1					
WQ0029	Insecta	Ephemeroptera	*Hexagenia sp.*				1				
WQ0029	Insecta	Ephemeroptera	*Stenacron sp.*		14	39	13	5.37%	5.67%	9.91%	13.86%
WQ0029	Insecta	Hemiptera	Corixidae unidentified	7		1					
WQ0029	Insecta	Hemiptera	Saldidae unidentified			1					
WQ0029	Insecta	Hemiptera	*Belostoma sp.*			1					
WQ0029	Insecta	Hemiptera	*Hesperocorixa alternata*	3							
WQ0029	Insecta	Hemiptera	*Notonecta sp.*			1					
WQ0029	Insecta	Hemiptera	*Plea striola*		1	8	4				
WQ0029	Insecta	Hemiptera	*Renatra fusca*				2				
WQ0029	Insecta	Hemiptera	*Sigara lineata*	2							
WQ0029	Insecta	Hemiptera	*Sigara sp.*	4	1		2	10.74%	0.60%	2.76%	7.92%
WQ0029	Insecta	Megaloptera	*Sialis sp.*		1	3		0.00%	0.30%	0.69%	0.00%
WQ0029	Insecta	Odonata	*Anax sp.*			1					
WQ0029	Insecta	Odonata	*Calopteryx sp.*			3					
WQ0029	Insecta	Odonata	*Enallagma sp.*	1		2		0.67%	0.00%	1.38%	0.00%
WQ0029	Annelida	Hirudinea	*Placobdella montifera*		1			0.00%	0.30%	0.00%	0.00%
WQ0029	Annelida	Branchiobdellida	*Branchiobdella sp.*	42							
WQ0029	Annelida	Branchiobdellida	*Cambarincola sp.*		5	97		28.19%	1.49%	22.35%	0.00%
WQ0029	Annelida	Oligochaeta	*Aeolosoma sp.*		7						
WQ0029	Annelida	Oligochaeta	*Limnodrilus sp.*			11	3				
WQ0029	Annelida	Oligochaeta	*Naidium sp.*		1						
WQ0029	Annelida	Oligochaeta	*Nais sp.*				1				
WQ0029	Annelida	Oligochaeta	*Paranais sp.*		1	2					
WQ0029	Annelida	Oligochaeta	*Tubifex sp.*			2	5	0.00%	2.69%	3.46%	8.91%
WQ0029	Gastropoda	Clenobranchiata	*Amnicola walkeri*				1				
WQ0029	Gastropoda	Pulmonata	*Ferrissia rivularis*	1	3						
WQ0029	Gastropoda	Pulmonata	*Ferrissia sp.*		1	14	1				
WQ0029	Gastropoda	Pulmonata	*Physa sp.*		9	3	2	0.67%	3.88%	3.92%	3.96%
WQ0029	Pelecypoda	Sphaeridae	*Pisidium sp.*		3	3	1				
WQ0029	Pelecypoda	Sphaeridae	*Sphaerium simile*	13			3				
WQ0029	Pelecypoda	Sphaeridae	*Sphaerium sp.*	7	68	24	7				
WQ0029	Pelecypoda	Unionidae	*Anodonta grandis*		2			13.42%	21.79%	6.22%	10.89%
WQ0029	**Total**			**149**	**335**	**434**	**101**	100.00%	100.00%	100.00%	100.00%
WQ0038	**Brokenhead River, PTH 59 at Scanterbury, total of 5 samples per site per year*.**										
WQ0038	Arachnoidae	Hydracarina	*Arrenurus sp.*			1	1				
WQ0038	Arachnoidae	Hydracarina	*Hydrachna sp.*				1				
WQ0038	Arachnoidae	Hydracarina	*Limnesia sp.*			1		0.00%	0.00%	0.36%	0.56%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon				% Order or Subclass			
				1995	1996	1997	1998	1995	1996	1997	1998
WQ0038	**Brokenhead River, PTH 59 at Scanterbury, total of 5 samples per site per year[a] (continued).**										
WQ0038	Crustacea	Amphipoda	*Crangonyx sp.*		1						
WQ0038	Crustacea	Amphipoda	*Gammarus sp.*		1	1					
WQ0038	Crustacea	Amphipoda	*Hyalella azteca*	298	356	399	89	66.97%	64.86%	71.68%	25.14%
WQ0038	Crustacea	Decapoda	*Orconectes immunis*	3							
WQ0038	Crustacea	Decapoda	*Orconectes virilis*		2	1					
WQ0038	Crustacea	Decapoda	*Orconectes sp.*		2		1	0.67%	0.72%	0.18%	0.28%
WQ0038	Insecta	Coleoptera	*Dubiraphia sp.*	22	36	17	11				
WQ0038	Insecta	Coleoptera	Haliplus sp.			1		4.94%	6.52%	3.23%	3.11%
WQ0038	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*	6	2	2	1				
WQ0038	Insecta	Diptera Chironomidae	*Chironomus sp.*	1		1	1				
WQ0038	Insecta	Diptera Chironomidae	*Clinotanypus sp.*				2				
WQ0038	Insecta	Diptera Chironomidae	*Corynoneura sp.*				1				
WQ0038	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*		1						
WQ0038	Insecta	Diptera Chironomidae	*Cryptotendipes sp.*				1				
WQ0038	Insecta	Diptera Chironomidae	*Dicrotendipes sp.*	1	2						
WQ0038	Insecta	Diptera Chironomidae	*Endochironomus sp.*	10							
WQ0038	Insecta	Diptera Chironomidae	*Epoicocladius sp.*				1				
WQ0038	Insecta	Diptera Chironomidae	*Lauterborniella sp.*			1					
WQ0038	Insecta	Diptera Chironomidae	*Microtendipes sp.*	1	2	2	2				
WQ0038	Insecta	Diptera Chironomidae	*Parachironomus sp.*				3				
WQ0038	Insecta	Diptera Chironomidae	*Paramerina sp.*		4						
WQ0038	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*	4	4	2					
WQ0038	Insecta	Diptera Chironomidae	*Polypedilium sp.*			1	2				
WQ0038	Insecta	Diptera Chironomidae	*Procladius sp.*	5		2					
WQ0038	Insecta	Diptera Chironomidae	*Tanytarsus sp.*		1	2		6.29%	2.90%	2.33%	3.95%
WQ0038	Insecta	Diptera Miscelaneous	*Chaoborus sp.*		1						
WQ0038	Insecta	Diptera Miscelaneous	*Chrysops sp.*	2	1	1					
WQ0038	Insecta	Diptera Miscelaneous	*Limnophora sp.*			1					
WQ0038	Insecta	Diptera Miscelaneous	*Palpomyia sp.*	1	7		4	0.67%	1.63%	0.36%	1.13%
WQ0038	Insecta	Ephemeroptera	Ephemeroptera unidentified	3							
WQ0038	Insecta	Ephemeroptera	*Caenis sp.*	23	61	67	154				
WQ0038	Insecta	Ephemeroptera	*Callibaetis sp.*			2	2				
WQ0038	Insecta	Ephemeroptera	*Centroptilum sp.*				10				
WQ0038	Insecta	Ephemeroptera	*Hexagenia limbata*	9	10	1					
WQ0038	Insecta	Ephemeroptera	*Leptophlebia sp.*	1							
WQ0038	Insecta	Ephemeroptera	*Paraleptophlebia sp.*		9	2	14				
WQ0038	Insecta	Ephemeroptera	*Stenacron sp.*	2		1	14				
WQ0038	Insecta	Ephemeroptera	*Stenonema sp.*				1				
WQ0038	Insecta	Ephemeroptera	*Tricorythodes sp.*				1	8.54%	14.49%	13.08%	55.37%
WQ0038	Insecta	Hemiptera	Corixidae unidentified	5		2	1				
WQ0038	Insecta	Hemiptera	*Hesperocorixa sp.*	1							
WQ0038	Insecta	Hemiptera	*Notonecta sp.*				1				
WQ0038	Insecta	Hemiptera	*Palmacorixa sp.*			1	1				
WQ0038	Insecta	Hemiptera	*Renatra fusca*				1				
WQ0038	Insecta	Hemiptera	*Sigara fallenoidea*			1					
WQ0038	Insecta	Hemiptera	*Sigara sp.*	4	5			2.25%	0.91%	0.72%	1.13%
WQ0038	Insecta	Megaloptera	*Sialis sp.*	1				0.22%	0.00%	0.00%	0.00%
WQ0038	Insecta	Odonata	*Basiaeschna sp.*				1				
WQ0038	Insecta	Odonata	*Enallagma sp.*	11	17	15	8				
WQ0038	Insecta	Odonata	Ischnura sp.			3	5	2.47%	3.08%	3.23%	3.95%
WQ0038	Insecta	Trichoptera	*Hydroptila sp.*			3					
WQ0038	Insecta	Trichoptera	*Phryganea sp.*		2						
WQ0038	Insecta	Trichoptera	*Polycentropus sp.*	15	8	2	1	3.37%	1.81%	0.90%	0.28%
WQ0038	Coelenterata	Coelenterata	*Hydra sp.*				1	0.00%	0.00%	0.00%	0.28%
WQ0038	Annelida	Hirudinea	*Dina sp.*			2					
WQ0038	Annelida	Hirudinea	*Helobdella stagnalis*				1				
WQ0038	Annelida	Hirudinea	*Helobdella sp.*		2	1	1				
WQ0038	Annelida	Hirudinea	*Placobdella montifera*				1	0.00%	0.36%	0.54%	0.85%
WQ0038	Annelida	Branchiobdellida	*Cambarincola sp.*			1		0.00%	0.00%	0.18%	0.00%
WQ0038	Annelida	Oligochaeta	*Aeolosoma sp.*	1							
WQ0038	Annelida	Oligochaeta	*Limnodrilus sp.*			1	2				
WQ0038	Annelida	Oligochaeta	*Nais sp.*				3				
WQ0038	Annelida	Oligochaeta	*Paranais sp.*			1					
WQ0038	Annelida	Oligochaeta	*Stylaria lacustris*			1					
WQ0038	Annelida	Oligochaeta	*Tubifex sp.*			1	1				
WQ0038	Annelida	Oligochaeta	*Lumbriculus inconstans*		1			0.22%	0.18%	0.72%	1.69%
WQ0038	Gastropoda	Ctenobranchiata	*Amnicola limosa*				2				
WQ0038	Gastropoda	Ctenobranchiata	*Marstonia decepta*	1							
WQ0038	Gastropoda	Pulmonata	Ferrissia sp.			5	1				
WQ0038	Gastropoda	Pulmonata	*Gyraulus sp.*		8	3					
WQ0038	Gastropoda	Pulmonata	*Physa sp.*	5		5	4				
WQ0038	Gastropoda	Pulmonata	*Planorbula sp.*		1						
WQ0038	Gastropoda	Pulmonata	*Promenetus exacuous*			1		1.35%	1.63%	2.51%	1.98%
WQ0038	Pelecypoda	Sphaeridae	*Sphaerium sp.*	9	4		1				
WQ0038	Pelecypoda	Unionidae	Unionidae unidentified		1			2.02%	0.91%	0.00%	0.28%
WQ0038	**Total**			**445**	**552**	**558**	**354**	100.00%	100.00%	100.00%	100.00%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon				% Order or Subclass			
				1995	1996	1997	1998	1995	1996	1997	1998
WQ0068	**La Salle River, PTH 75 at St. Norbert, total of 5 samples per site per year*.**										
WQ0068	Arachnoidae	Hydracarina	Hydracarina unidentified		3	2					
WQ0068	Arachnoidae	Hydracarina	*Limnesia sp.*			2		0.00%	3.80%	1.78%	0.00%
WQ0068	Crustacea	Amphipoda	*Hyalella azteca*	3	29	3		6.25%	36.71%	1.33%	0.00%
WQ0068	Insecta	Coleoptera	*Bledius sp.*				1				
WQ0068	Insecta	Coleoptera	*Dubiraphia sp.*	3	1	7	1				
WQ0068	Insecta	Coleoptera	*Haliplus borealis*		1						
WQ0068	Insecta	Coleoptera	*Peltodytes sp.*	1				8.33%	2.53%	3.11%	4.55%
WQ0068	Insecta	Diptera Chironomidae	*Chironomus plumosus*	2							
WQ0068	Insecta	Diptera Chironomidae	*Chironomus sp.*		1	59	26				
WQ0068	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*	16	1						
WQ0068	Insecta	Diptera Chironomidae	*Glyptotendipes sp.*			2	1				
WQ0068	Insecta	Diptera Chironomidae	*Parachironomus sp.*			2					
WQ0068	Insecta	Diptera Chironomidae	*Polypedilum sp.*	1	1						
WQ0068	Insecta	Diptera Chironomidae	*Procladius sp.*	2		99					
WQ0068	Insecta	Diptera Chironomidae	*Tanypus sp.*	2				47.92%	3.80%	72.00%	61.36%
WQ0068	Insecta	Diptera Miscelaneous	*Chaoborus sp.*			2					
WQ0068	Insecta	Diptera Miscelaneous	*Palpomyia sp.*	1		1					
WQ0068	Insecta	Diptera Miscelaneous	*Tipula sp.*			1		2.08%	0.00%	1.78%	0.00%
WQ0068	Insecta	Ephemeroptera	Ephemeroptera unidentified			1					
WQ0068	Insecta	Ephemeroptera	*Caenis sp.*	6	7	5	1	12.50%	8.86%	2.67%	2.27%
WQ0068	Insecta	Hemiptera	Corixidae unidentified	1	23						
WQ0068	Insecta	Hemiptera	*Palmacorixa buenoi*			4	1				
WQ0068	Insecta	Hemiptera	*Palmacorixa sp.*				5				
WQ0068	Insecta	Hemiptera	*Trichocorixa borealis*		1						
WQ0068	Insecta	Hemiptera	*Trichocorixa naias*		1			2.08%	31.65%	1.78%	13.64%
WQ0068	Insecta	Megaloptera	*Chauliodes sp.*			1					
WQ0068	Insecta	Megaloptera	*Sialis sp.*			31		0.00%	0.00%	14.22%	0.00%
WQ0068	Insecta	Trichoptera	*Oecetis sp.*		1						
WQ0068	Insecta	Trichoptera	*Phryganea sp.*	1				2.08%	1.27%	0.00%	0.00%
WQ0068	Insecta	Odonata	*Enallagma sp.*	3	1			6.25%	1.27%	0.00%	0.00%
WQ0068	Annelida	Hirudinea	*Placobdella sp.*			1		0.00%	0.00%	0.44%	0.00%
WQ0068	Annelida	Oligochaeta	Tubificidae unidentified			1					
WQ0068	Annelida	Oligochaeta	*Limnodrilus udekemianus*	2							
WQ0068	Annelida	Oligochaeta	*Limnodrilus sp.*				6	4.17%	0.00%	0.44%	13.64%
WQ0068	Gastropoda	Clenobranchiata	*Marstonia decepta*	1							
WQ0068	Gastropoda	Pulmonata	*Armiger crista*	1							
WQ0068	Gastropoda	Pulmonata	*Ferrissia rivularis*	1	2						
WQ0068	Gastropoda	Pulmonata	*Gyraulus sp.*		5						
WQ0068	Gastropoda	Pulmonata	*Lymnaea sp.*	1							
WQ0068	Gastropoda	Pulmonata	*Physa sp.*		1		1	8.33%	10.13%	0.00%	2.27%
WQ0068	Pelecypoda	Sphaeriidae	*Sphaerium sp.*				1				
WQ0068	Pelecypoda	Unionidae	Unionidae unidentified			1		0.00%	0.00%	0.44%	2.27%
WQ0068	**Total**			**48**	**79**	**225**	**44**	100.00%	100.00%	100.00%	100.00%
WQ0105	**Little Saskatchewan River, PTH 25 at Rivers, total of 5 samples per site per year*.**										
WQ0105	Arachnoidae	Hydracarina	Hydracarina unidentified	4	4						
WQ0105	Arachnoidae	Hydracarina	*Arrenurus sp.*			2	2				
WQ0105	Arachnoidae	Hydracarina	*Limnesia sp.*		1	2	5				
WQ0105	Arachnoidae	Hydracarina	*Sperchon sp.*		1						
WQ0105	Arachnoidae	Hydracarina	Unionicola sp.			8	3	0.09%	0.09%	0.31%	0.32%
WQ0105	Crustacea	Amphipoda	*Gammarus sp.*	9	3	2	2				
WQ0105	Crustacea	Amphipoda	*Hyalella azteca*	3897	5491	3476	2047	83.59%	78.62%	90.93%	66.65%
WQ0105	*Crustacea*	*Conchostraca*	*Cyzicus mexicanus*			1		0.00%	0.00%	0.03%	0.00%
WQ0105	Crustacea	Decapoda	*Orconectes virilis*		3						
WQ0105	Crustacea	Decapoda	*Orconectes sp.*			1		0.00%	0.04%	0.03%	0.00%
WQ0105	Insecta	Coleoptera	Elmidae unidentified				1				
WQ0105	Insecta	Coleoptera	*Agabinus sp.*		2						
WQ0105	Insecta	Coleoptera	*Bledius sp.*		1						
WQ0105	Insecta	Coleoptera	*Haliplus sp.*				2				
WQ0105	Insecta	Coleoptera	*Hydaticus sp.*	4							
WQ0105	Insecta	Coleoptera	*Hydroporus sp.*		1		4				
WQ0105	Insecta	Coleoptera	*Liodessus affinis*		1						
WQ0105	Insecta	Coleoptera	*Optioservus sp.*		15						
WQ0105	Insecta	Coleoptera	*Stenelmis sp.*		1			0.09%	0.30%	0.00%	0.22%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon 1995	1996	1997	1998	% Order or Subclass 1995	1996	1997	1998
WQ0105	**Little Saskatchewan River, PTH 25 at Rivers, total of 5 samples per site per year* (continued).**										
WQ0105	Insecta	Diptera Chironomidae	Chironomidae unidentified			11	18				
WQ0105	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*	15	3	1	2				
WQ0105	Insecta	Diptera Chironomidae	*Chironomus sp.*			2	45				
WQ0105	Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*			1					
WQ0105	Insecta	Diptera Chironomidae	*Cricotopus sp.*		1	28					
WQ0105	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*	3	2						
WQ0105	Insecta	Diptera Chironomidae	*Dicrotendipes sp.*	349	37	3	5				
WQ0105	Insecta	Diptera Chironomidae	*Endochironomus sp.*	41							
WQ0105	Insecta	Diptera Chironomidae	*Glyptotendipes sp.*		10		1				
WQ0105	Insecta	Diptera Chironomidae	*Isocladius sp.*			1					
WQ0105	Insecta	Diptera Chironomidae	*Microtendipes sp.*	36	7	11	22				
WQ0105	Insecta	Diptera Chironomidae	*Parachironomus sp.*	4	2						
WQ0105	Insecta	Diptera Chironomidae	*Paratanytarsus sp.*		1		2				
WQ0105	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*	8	1	8	12				
WQ0105	Insecta	Diptera Chironomidae	*Polthastia sp.*		1						
WQ0105	Insecta	Diptera Chironomidae	*Polypedilium sp.*			2					
WQ0105	Insecta	Diptera Chironomidae	*Procladius sp.*	3		7	3				
WQ0105	Insecta	Diptera Chironomidae	*Psectrocladius sp.*			7					
WQ0105	Insecta	Diptera Chironomidae	*Rheotanytarsus sp.*	4	4						
WQ0105	Insecta	Diptera Chironomidae	*Stenochironomus sp.*			2					
WQ0105	Insecta	Diptera Chironomidae	*Stictochironomus sp.*	3	1						
WQ0105	Insecta	Diptera Chironomidae	*Tanytarsus sp.*			3		9.97%	1.00%	2.27%	3.52%
WQ0105	Insecta	Diptera Miscelaneous	Diptera Misc. unidentified	1							
WQ0105	Insecta	Diptera Miscelaneous	*Chrysops sp.*	2	2						
WQ0105	Insecta	Diptera Miscelaneous	*Palpomyia sp.*			2					
WQ0105	Insecta	Diptera Miscelaneous	Simuliidae unidentified		1	1					
WQ0105	Insecta	Diptera Miscelaneous	*Simulium sp.*		2			0.06%	0.07%	0.08%	0.00%
WQ0105	Insecta	Ephemeroptera	*Baetis sp.*	1	6	4					
WQ0105	Insecta	Ephemeroptera	*Caenis sp.*	61	655	180	549				
WQ0105	Insecta	Ephemeroptera	*Callibaetis sp.*	1			161				
WQ0105	Insecta	Ephemeroptera	*Ephemera sp.*		1		1				
WQ0105	Insecta	Ephemeroptera	*Leptophlebia sp.*	65	1						
WQ0105	Insecta	Ephemeroptera	*Paraleptophlebia sp.*		10	10	1				
WQ0105	Insecta	Ephemeroptera	*Stenacron sp.*	7	48	19	22				
WQ0105	Insecta	Ephemeroptera	*Stenonema sp.*	2	2						
WQ0105	Insecta	Ephemeroptera	*Tricorythodes sp.*	8	6			3.10%	10.32%	5.57%	23.52%
WQ0105	Insecta	Hemiptera	Corixidae unidentified			3	4				
WQ0105	Insecta	Hemiptera	*Callicorixa sp.*		4						
WQ0105	Insecta	Hemiptera	*Hesperocorixa vulgaris*		1						
WQ0105	Insecta	Hemiptera	*Saldula sp.*		2						
WQ0105	Insecta	Hemiptera	*Sigara decoratella*		9						
WQ0105	Insecta	Hemiptera	*Sigara fallenoidea*		1	1					
WQ0105	Insecta	Hemiptera	*Sigara lineata*	1							
WQ0105	Insecta	Hemiptera	*Sigara sp.*	4	6		6				
WQ0105	Insecta	Hemiptera	*Trichocorixa borealis*				4				
WQ0105	Insecta	Hemiptera	*Trichocorixa naias*		1						
WQ0105	Insecta	Hemiptera	*Trichocorixa verticalis*			1		0.11%	0.34%	0.13%	0.45%
WQ0105	Insecta	Lepidoptera	*Acentria sp.*	1	1	1		0.02%	0.01%	0.03%	0.00%
WQ0105	Insecta	Odonata	*Enallagma sp.*	6	1		24	0.13%	0.01%	0.00%	0.77%
WQ0105	Insecta	Trichoptera	*Ceraclea sp.*		2						
WQ0105	Insecta	Trichoptera	*Cheumatopsyche sp.*	44	23		1				
WQ0105	Insecta	Trichoptera	*Helicopsyche sp.*	1	5	1	2				
WQ0105	Insecta	Trichoptera	*Hydropsyche sp.*	19							
WQ0105	Insecta	Trichoptera	*Hydroptila sp.*			3					
WQ0105	Insecta	Trichoptera	Hydroptilidae unidentified		6	4					
WQ0105	Insecta	Trichoptera	*Neureclipsis sp.*	22	158		2				
WQ0105	Insecta	Trichoptera	*Oecetis sp.*	9	8		2				
WQ0105	Insecta	Trichoptera	*Polycentropus sp.*				1				
WQ0105	Insecta	Trichoptera	*Psychomyia sp.*		2						
WQ0105	Insecta	Trichoptera	*Ptilostomis sp.*		3						
WQ0105	Insecta	Trichoptera	*Triaenodes sp.*				1	2.03%	2.96%	0.21%	0.29%
WQ0105	Coelenterata	Coelenterata	*Hydra sp.*		6			0.00%	0.09%	0.00%	0.00%
WQ0105	Annelida	Hirudinea	*Dina sp.*		1		2				
WQ0105	Annelida	Hirudinea	*Glossiphonia complanata*		1	1					
WQ0105	Annelida	Hirudinea	*Helobdella stagnalis*	1	1		1				
WQ0105	Annelida	Hirudinea	*Helobdella sp.*				2	0.02%	0.04%	0.03%	0.16%
WQ0105	Annelida	Oligochaeta	*Aeolosoma sp.*	3	1						
WQ0105	Annelida	Oligochaeta	*Dero sp.*				47				
WQ0105	Annelida	Oligochaeta	*Limnodrilus cacustis*				1				
WQ0105	Annelida	Oligochaeta	*Naidium sp.*		2						
WQ0105	Annelida	Oligochaeta	*Nais sp.*		1	1	7				
WQ0105	Annelida	Oligochaeta	*Paranais sp.*		12						
WQ0105	Annelida	Oligochaeta	*Pristina sp.*			2					
WQ0105	Annelida	Oligochaeta	*Stylaria lacustris*			2	1				
WQ0105	Annelida	Oligochaeta	*Tubifex sp.*			4	75	0.06%	0.23%	0.24%	4.20%
WQ0105	Nematomorph	Nematomorpha	Nematomorpha unidentified		2			0.00%	0.03%	0.00%	0.00%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon 1995	1996	1997	1998	% Order or Subclass 1995	1996	1997	1998
WQ0105	**Little Saskatchewan River, PTH 25 at Rivers, total of 5 samples per site per year* (continued).**										
WQ0105	Gastropoda	Ctenobranchiata	*Valvata tricarinata*	14	27						
WQ0105	Gastropoda	Pulmonata	*Ferrissia rivularis*	9							
WQ0105	Gastropoda	Pulmonata	*Ferrissia sp.*		91						
WQ0105	Gastropoda	Pulmonata	*Gyraulus sp.*	5	64		2				
WQ0105	Gastropoda	Pulmonata	*Physa sp.*	4	181	1	6	0.68%	5.19%	0.03%	0.26%
WQ0105	Pelecypoda	Sphaeriidae	*Pisidium sp.*	2	45	5	20	0.04%	0.64%	0.13%	0.64%
WQ0105	**Total**			4673	6988	3825	3121	100.00%	100.00%	100.00%	100.00%
WQ0131	**Rat River, PR 303 at Otterburne, total of 5 samples per site per year*.**										
WQ0131	Arachnoidae	Hydracanna	Hydracanna unidentified				1	0.00%	0.00%	0.00%	0.27%
WQ0131	Crustacea	Amphipoda	*Hyalella azteca*	2		6		0.30%	0.00%	0.82%	0.00%
WQ0131	Crustacea	Decapoda	*Orconectes immunis*	6							
WQ0131	Crustacea	Decapoda	*Orconectes virilis*		2						
WQ0131	Crustacea	Decapoda	*Orconectes sp.*			13	16	0.90%	0.42%	1.33%	4.30%
WQ0131	Insecta	Coleoptera	*Cleptelmis sp.*		1						
WQ0131	Insecta	Coleoptera	*Dubiraphia sp.*	1	2						
WQ0131	Insecta	Coleoptera	*Gyrinus sp.*	3	1						
WQ0131	Insecta	Coleoptera	*Helophorus sp.*			1					
WQ0131	Insecta	Coleoptera	*Liodessus affinis*	1							
WQ0131	Insecta	Coleoptera	*Optioservus sp.*			1					
WQ0131	Insecta	Coleoptera	*Liodessus sp.*	1							
WQ0131	Insecta	Coleoptera	*Stenelmis sp.*		4		1	0.90%	1.69%	0.20%	0.27%
WQ0131	Insecta	Diptera Chironomidae	Chironomidae unidentified			17	2				
WQ0131	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*		15	5	3				
WQ0131	Insecta	Diptera Chironomidae	*Chironomus sp.*		1	1	2				
WQ0131	Insecta	Diptera Chironomidae	*Chironomus thummi*	1							
WQ0131	Insecta	Diptera Chironomidae	*Cricotopus sp.*	7	4	3					
WQ0131	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*				4				
WQ0131	Insecta	Diptera Chironomidae	*Demicryptochironomus sp.*	1	4	1	1				
WQ0131	Insecta	Diptera Chironomidae	*Endochironomus sp.*	1	1						
WQ0131	Insecta	Diptera Chironomidae	*Micropsectra sp.*		1						
WQ0131	Insecta	Diptera Chironomidae	*Microtendipes sp.*	1		1	1				
WQ0131	Insecta	Diptera Chironomidae	*Paralauterborniella sp.*		1						
WQ0131	Insecta	Diptera Chironomidae	*Paramerina sp.*		5						
WQ0131	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*	1	1		1				
WQ0131	Insecta	Diptera Chironomidae	*Polypedilum sp.*	1	2	3	1				
WQ0131	Insecta	Diptera Chironomidae	*Procladius sp.*				1				
WQ0131	Insecta	Diptera Chironomidae	*Stictochironomus sp.*				2				
WQ0131	Insecta	Diptera Chironomidae	*Tanytarsus sp.*		1	1	2				
WQ0131	Insecta	Diptera Chironomidae	*Thienemanniella sp.*	8							
WQ0131	Insecta	Diptera Chironomidae	*Tribelos sp.*	11				4.83%	7.59%	3.28%	5.38%
WQ0131	Insecta	Diptera Miscelaneous	*Hemerodromia sp.*			3					
WQ0131	Insecta	Diptera Miscelaneous	*Palpomyia sp.*	1	1		26				
WQ0131	Insecta	Diptera Miscelaneous	Simulidae unidentified	4							
WQ0131	Insecta	Diptera Miscelaneous	*Simulium sp.*	3	10			1.21%	2.32%	0.31%	6.99%
WQ0131	Insecta	Ephemeroptera	Ephemeroptera unidentified				2				
WQ0131	Insecta	Ephemeroptera	*Baetis sp.*	126	104	48	7				
WQ0131	Insecta	Ephemeroptera	*Caenis sp.*	30	57	51	68				
WQ0131	Insecta	Ephemeroptera	*Callibaetis sp.*	1							
WQ0131	Insecta	Ephemeroptera	*Centroptilum sp.*			1	1				
WQ0131	Insecta	Ephemeroptera	*Heptagenia sp.*	1							
WQ0131	Insecta	Ephemeroptera	*Hexagenia limbata*	5	6		10				
WQ0131	Insecta	Ephemeroptera	*Hexagenia sp.*			5					
WQ0131	Insecta	Ephemeroptera	*Paraleptophlebia sp.*	8		4	3				
WQ0131	Insecta	Ephemeroptera	*Stenacron sp.*	235	53	193	26				
WQ0131	Insecta	Ephemeroptera	*Stenonema sp.*		1		3				
WQ0131	Insecta	Ephemeroptera	*Tricorythodes sp.*			1		61.24%	46.62%	31.01%	32.26%
WQ0131	Insecta	Hemiptera	Corixidae unidentified				88				
WQ0131	Insecta	Hemiptera	*Belostoma flumineum*	1							
WQ0131	Insecta	Hemiptera	*Metrobates hesperius*				2				
WQ0131	Insecta	Hemiptera	*Palmacorixa sp.*			2					
WQ0131	Insecta	Hemiptera	*Rheumatobates sp.*	1							
WQ0131	Insecta	Hemiptera	*Sigara lineata*	31			62				
WQ0131	Insecta	Hemiptera	*Sigara sp.*	1	1	3	9				
WQ0131	Insecta	Hemiptera	*Trichocorixa naias*	1			2				
WQ0131	Insecta	Hemiptera	*Trichocorixa sp.*				2	5.28%	0.21%	0.51%	44.35%
WQ0131	Insecta	Megaloptera	*Sialis sp.*		1			0.00%	0.21%	0.00%	0.00%
WQ0131	Insecta	Odonata	*Calopteryx sp.*	1							
WQ0131	Insecta	Odonata	*Dromogomphus sp.*		1			0.15%	0.21%	0.00%	0.00%
WQ0131	Insecta	Trichoptera	*Ceraclea sp.*				1				
WQ0131	Insecta	Trichoptera	*Cheumatopsyche sp.*	2	94	45	2				
WQ0131	Insecta	Trichoptera	*Hydatophylax sp.*	3							
WQ0131	Insecta	Trichoptera	*Hydropsyche sp.*	2	92	3					
WQ0131	Insecta	Trichoptera	*Polycentropus sp.*	1							
WQ0131	Insecta	Trichoptera	*Ptilostomis sp.*	1				1.36%	39.24%	4.91%	0.81%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon				% Order or Subclass			
				1995	1996	1997	1998	1995	1996	1997	1998
WQ0131	**Rat River, PR 303 at Otterburne, total of 5 samples per site per year* (continued).**										
WQ0131	Annelida	Branchiobdellida	*Cambarincola sp.*			7	7	0.00%	0.00%	0.72%	1.88%
WQ0131	Annelida	Oligochaeta	*Aeolosoma sp.*	1							
WQ0131	Annelida	Oligochaeta	*Limnodrilus sp.*			2					
WQ0131	Annelida	Oligochaeta	*Nais sp.*			3					
WQ0131	Annelida	Oligochaeta	*Paranais sp.*		3	1		0.15%	0.63%	0.61%	0.00%
WQ0131	Gastropoda	Ctenobranchiata	*Amnicola limosa*			10	5				
WQ0131	Gastropoda	Ctenobranchiata	*Amnicola walkeri*	1							
WQ0131	Gastropoda	Ctenobranchiata	*Cincinnatia cincinnatiensis*			8	5				
WQ0131	Gastropoda	Pulmonata	*Ferrissia rivularis*	150							
WQ0131	Gastropoda	Pulmonata	*Ferrissia sp.*			11					
WQ0131	Gastropoda	Pulmonata	*Physa sp.*	1	1			22.93%	0.21%	2.97%	2.69%
WQ0131	Pelecypoda	Sphaeriidae	*Pisidium sp.*				1				
WQ0131	Pelecypoda	Sphaeriidae	*Sphaerium simile*	5							
WQ0131	Pelecypoda	Sphaeriidae	*Sphaerium sp.*		3		2				
WQ0131	Pelecypoda	Unionidae	Anodonta grandis			521		0.75%	0.63%	53.33%	0.81%
WQ0131	**Total**			**663**	**474**	**977**	**372**	100.00%	100.00%	100.00%	100.00%
WQ0153	**Roseau River at dam, west of PR 200, total of 5 samples per site per year*.**										
WQ0153	Crustacea	Amphipoda	Hyalella azteca			1	1	0.00%	0.00%	1.06%	1.09%
WQ0153	Crustacea	Decapoda	*Orconectes sp.*				1	0.00%	0.00%	0.00%	1.09%
WQ0153	Insecta	Coleoptera	*Dubiraphia sp.*	1		3	1				
WQ0153	Insecta	Coleoptera	*Stenelmis sp.*	5	2	1	1	4.58%	3.70%	4.26%	2.17%
WQ0153	Insecta	Diptera Chironomidae	Chironomidae unidentified				4				
WQ0153	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*	2		3					
WQ0153	Insecta	Diptera Chironomidae	*Chironomus sp.*			1	6				
WQ0153	Insecta	Diptera Chironomidae	*Chironomus thummi*	1							
WQ0153	Insecta	Diptera Chironomidae	*Cryptotendipes sp.*			1					
WQ0153	Insecta	Diptera Chironomidae	*Demicryptochironomus sp.*		1						
WQ0153	Insecta	Diptera Chironomidae	*Krenosmittia sp.*	2							
WQ0153	Insecta	Diptera Chironomidae	*Labrundinia sp.*	1							
WQ0153	Insecta	Diptera Chironomidae	*Paralauterborniella sp.*				1				
WQ0153	Insecta	Diptera Chironomidae	*Polypedilium sp.*			2	1				
WQ0153	Insecta	Diptera Chironomidae	*Psectrocladius sp.*				1				
WQ0153	Insecta	Diptera Chironomidae	*Tanytarsus sp.*				1	4.58%	1.85%	7.45%	15.22%
WQ0153	Insecta	Diptera Miscelaneous	*Palpomyia sp.*				9	0.00%	0.00%	0.00%	9.78%
WQ0153	Insecta	Ephemeroptera	Baetidae unidentified			1	1				
WQ0153	Insecta	Ephemeroptera	*Baetis sp.*	2	1	1					
WQ0153	Insecta	Ephemeroptera	*Baetisca sp.*				3				
WQ0153	Insecta	Ephemeroptera	*Callibaetis sp.*		2		16				
WQ0153	Insecta	Ephemeroptera	*Caenis sp.*				1				
WQ0153	Insecta	Ephemeroptera	*Centroptilum sp.*	3	7	1	3				
WQ0153	Insecta	Ephemeroptera	*Ephemera sp.*			2					
WQ0153	Insecta	Ephemeroptera	*Heptagenia sp.*		2	2					
WQ0153	Insecta	Ephemeroptera	*Hexagenia sp.*				1				
WQ0153	Insecta	Ephemeroptera	*Leptophlebia sp.*				2				
WQ0153	Insecta	Ephemeroptera	*Paraleptophlebia sp.*	1		3	6				
WQ0153	Insecta	Ephemeroptera	*Potamanthus sp.*	2	1	3					
WQ0153	Insecta	Ephemeroptera	*Stenacron sp.*	19	1	8					
WQ0153	Insecta	Ephemeroptera	*Stenonema sp.*	30	22	23	10				
WQ0153	Insecta	Ephemeroptera	*Tricorythodes sp.*	1	3	3	6	44.27%	72.22%	50.00%	53.26%
WQ0153	Insecta	Hemiptera	Corixidae unidentified	11			2				
WQ0153	Insecta	Hemiptera	*Sigara lineata*	45		2		42.75%	0.00%	2.13%	2.17%
WQ0153	Insecta	Megaloptera	Sialis sp.			3		0.00%	0.00%	3.19%	0.00%
WQ0153	Insecta	Odonata	*Dromogomphus sp.*		1	3	1	0.00%	1.85%	3.19%	1.09%
WQ0153	Insecta	Trichoptera	*Nectopsyche sp.*		11	22	6				
WQ0153	Insecta	Trichoptera	*Neureclipsis sp.*	2							
WQ0153	Insecta	Trichoptera	Trichoptera unidentified	1				2.29%	20.37%	23.40%	6.52%
WQ0153	Annelida	Branchiobdellida	*Cambarincola sp.*				5	0.00%	0.00%	0.00%	5.43%
WQ0153	Annelida	Oligochaeta	*Aeolosoma sp.*	1							
WQ0153	Annelida	Oligochaeta	*Limnodrilus sp.*			1		0.76%	0.00%	1.06%	0.00%
WQ0153	Gastropoda	Pulmonata	*Ferrissia sp.*			3		0.00%	0.00%	3.19%	0.00%
WQ0153	Pelecypoda	Sphaeriidae	*Sphaerium sp.*	1		1	2	0.76%	0.00%	1.06%	2.17%
WQ0153	**Total**			**131**	**54**	**94**	**92**	100.00%	100.00%	100.00%	100.00%
WQ0166	**Seine River at PTH 100, south of Winnipeg, total of 5 samples per site per year*.**										
WQ0166	Arachnoidae	Hydracarina	Hydracarina unidentified	10							
WQ0166	Arachnoidae	Hydracarina	*Hydrachna sp.*				2	2.28%	0.00%	0.00%	0.10%
WQ0166	Crustacea	Amphipoda	*Hyalella azteca*	120	9			27.33%	1.89%	0.00%	0.00%
WQ0166	Crustacea	Decapoda	*Orconectes immunis*	5							
WQ0166	Crustacea	Decapoda	*Orconectes virilis*		1						
WQ0166	Crustacea	Decapoda	*Orconectes sp.*				1	1.14%	0.21%	0.00%	0.05%
WQ0166	Insecta	Coleoptera	*Dubiraphia sp.*	11	4	3	23				
WQ0166	Insecta	Coleoptera	*Haliplus sp.*				22				
WQ0166	Insecta	Coleoptera	*Liodessus affinis*				1				
WQ0166	Insecta	Coleoptera	*Peltodytes edentulus*	3							
WQ0166	Insecta	Coleoptera	*Peltodytes sp.*	5			2	4.33%	0.84%	0.85%	2.38%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon 1995	1996	1997	1998	% Order or Subclass 1995	1996	1997	1998
WQ0166	**Seine River at PTH 100, south of Winnipeg, total of 5 samples per site per year* (continued).**										
WQ0166	Insecta	Diptera Chironomidae	Chironomidae unidentified		2						
WQ0166	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*			1	1				
WQ0166	Insecta	Diptera Chironomidae	*Chironomus sp.*	3	233	2					
WQ0166	Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*			3					
WQ0166	Insecta	Diptera Chironomidae	*Clinotanypus sp.*	5	18		22				
WQ0166	Insecta	Diptera Chironomidae	*Cricotopus sp.*		17	1					
WQ0166	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*			1					
WQ0166	Insecta	Diptera Chironomidae	*Dicrotendipes sp.*		5						
WQ0166	Insecta	Diptera Chironomidae	*Endochironomus sp.*	1			1				
WQ0166	Insecta	Diptera Chironomidae	*Paramerina sp.*				3				
WQ0166	Insecta	Diptera Chironomidae	*Paratendipes sp.*		3						
WQ0166	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*		46	1					
WQ0166	Insecta	Diptera Chironomidae	*Polypedilum sp.*	4	5						
WQ0166	Insecta	Diptera Chironomidae	*Procladius sp.*	2	2	46					
WQ0166	Insecta	Diptera Chironomidae	*Stictochironomus sp.*		3						
WQ0166	Insecta	Diptera Chironomidae	*Tanytarsus sp.*		15						
WQ0166	Insecta	Diptera Chironomidae	*Tribelos sp.*	1				3.64%	73.17%	15.67%	1.34%
WQ0166	Insecta	Diptera Miscelaneous	*Chaoborus sp.*		1						
WQ0166	Insecta	Diptera Miscelaneous	*Palpomyia sp.*	8	17	2	4	1.82%	3.77%	0.57%	0.20%
WQ0166	Insecta	Ephemeroptera	Ephemeroptera unidentified	3							
WQ0166	Insecta	Ephemeroptera	*Caenis sp.*		19	1	1				
WQ0166	Insecta	Ephemeroptera	*Hexagenia limbata*	1		5	19				
WQ0166	Insecta	Ephemeroptera	*Stenacron sp.*	3				1.59%	3.98%	1.71%	0.99%
WQ0166	Insecta	Hemiptera	Corixidae unidentified				6				
WQ0166	Insecta	Hemiptera	*Hesperocorixa sp.*	4							
WQ0166	Insecta	Hemiptera	*Macrovelia sp.*				1				
WQ0166	Insecta	Hemiptera	*Palmacorixa sp.*			1					
WQ0166	Insecta	Hemiptera	*Plea striola*			1	6				
WQ0166	Insecta	Hemiptera	*Sigara sp.*	12		1	1	3.64%	0.00%	0.85%	0.69%
WQ0166	Insecta	Lepidoptera	*Archanara sp.*			1		0.00%	0.00%	0.28%	0.00%
WQ0166	Insecta	Megaloptera	*Sialis sp.*	40	14	97	2	9.11%	2.94%	27.64%	0.10%
WQ0166	Insecta	Odonata	*Calopteryx sp.*	10							
WQ0166	Insecta	Odonata	*Enallagma sp.*	3			2	2.96%	0.00%	0.00%	0.10%
WQ0166	Insecta	Trichoptera	*Cheumatopsyche sp.*	1	1						
WQ0166	Insecta	Trichoptera	*Hydropsyche sp.*	1							
WQ0166	Insecta	Trichoptera	*Neureclipsis sp.*	2							
WQ0166	Insecta	Trichoptera	*Oecetis sp.*				1				
WQ0166	Insecta	Trichoptera	*Phryganea sp.*	1			1				
WQ0166	Insecta	Trichoptera	*Ptilostomis sp.*	11	1			3.64%	0.42%	0.00%	0.10%
WQ0166	Annelida	Hirudinea	*Dina sp.*	3	8	1	2				
WQ0166	Annelida	Hirudinea	*Nephelopsis obscura*	1							
WQ0166	Annelida	Hirudinea	*Helobdella stagnalis*				1				
WQ0166	Annelida	Hirudinea	*Placobdella montifera*	2			1	1.37%	1.68%	0.28%	0.20%
WQ0166	Annelida	Branchiobdellida	*Branchiobdella sp.*	3				0.68%	0.00%	0.00%	0.00%
WQ0166	Annelida	Oligochaeta	Oligochaeta unidentified		3						
WQ0166	Annelida	Oligochaeta	*Lumbriculus sp.*		6			0.00%	1.89%	0.00%	0.00%
WQ0166	Gastropoda	Ctenobranchiata	*Amincola limosa*	45	6	118	1580				
WQ0166	Gastropoda	Ctenobranchiata	*Amnicola sp.*	1							
WQ0166	Gastropoda	Ctenobranchiata	*Cincinnatia cincinnatiensis*		16	4	111				
WQ0166	Gastropoda	Ctenobranchiata	*Marstonia decepta*			5					
WQ0166	Gastropoda	Ctenobranchiata	*Valvata tricarinata*	7			1				
WQ0166	Gastropoda	Pulmonata	*Aplexa hypnorum*		1						
WQ0166	Gastropoda	Pulmonata	*Ferrissia rivularis*	39	3						
WQ0166	Gastropoda	Pulmonata	*Ferrissia sp.*		1	9	8				
WQ0166	Gastropoda	Pulmonata	*Gyraulus sp.*			1	56				
WQ0166	Gastropoda	Pulmonata	*Lymnaea sp.*		1		1				
WQ0166	Gastropoda	Pulmonata	*Physa sp.*	43	15	31	124	30.75%	9.01%	47.86%	93.30%
WQ0166	Pelecypoda	Sphaeriidae	*Sphaerium sp.*	25	1	15	9	5.69%	0.21%	4.27%	0.45%
WQ0166	**Total**			439	477	351	2016	100.00%	100.00%	100.00%	100.00%
WQ0197	**Whitemud River at Westbourne, total of 5 samples per site per year*.**										
WQ0197	Arachnoidae	Hydracarina	Arrenurus sp.			1					
WQ0197	Arachnoidae	Hydracarina	Lebertia sp.	1		1					
WQ0197	Arachnoidae	Hydracarina	Sperchon sp.			1					
WQ0197	Arachnoidae	Hydracarina	Unionicola sp.			3		0.28%	0.00%	0.79%	0.00%
WQ0197	Crustacea	Amphipoda	*Hyalella azteca*	5	92	28	9	1.40%	15.51%	3.69%	2.73%
WQ0197	Insecta	Coleoptera	*Berosus sp.*			1					
WQ0197	Insecta	Coleoptera	*Cleptelmis sp.*			1					
WQ0197	Insecta	Coleoptera	*Dubiraphia sp.*	2	2	5	7				
WQ0197	Insecta	Coleoptera	*Liodessus affinis*			1					
WQ0197	Insecta	Coleoptera	*Optioservus sp.*			14					
WQ0197	Insecta	Coleoptera	*Stenelmis sp.*	3		6		1.40%	0.34%	3.69%	2.12%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon				% Order or Subclass			
				1995	1996	1997	1998	1995	1996	1997	1998
WQ0197	**Whitemud River at Westbourne, total of 5 samples per site per year[a] (continued).**										
WQ0197	Insecta	Diptera Chironomidae	Chironomidae unidentified		25	22	1				
WQ0197	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*	1		6					
WQ0197	Insecta	Diptera Chironomidae	*Chironomus sp.*			2	20				
WQ0197	Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*			18					
WQ0197	Insecta	Diptera Chironomidae	*Cricotopus sp.*	12	27	5	2				
WQ0197	Insecta	Diptera Chironomidae	*Dicrotendipes sp.*	18		2					
WQ0197	Insecta	Diptera Chironomidae	*Einfeldia sp.*	5							
WQ0197	Insecta	Diptera Chironomidae	*Labrundinia sp.*	2		2					
WQ0197	Insecta	Diptera Chironomidae	*Microtendipes sp.*	4		3					
WQ0197	Insecta	Diptera Chironomidae	*Nanocladius sp.*			1					
WQ0197	Insecta	Diptera Chironomidae	*Natarsia sp.*	1							
WQ0197	Insecta	Diptera Chironomidae	*Paracladopelma sp.*	3		2					
WQ0197	Insecta	Diptera Chironomidae	*Paracryptochironomus sp.*	1							
WQ0197	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*			5	13				
WQ0197	Insecta	Diptera Chironomidae	*Paramerina sp.*		6						
WQ0197	Insecta	Diptera Chironomidae	*Polypedilum sp.*	36	12	11	3				
WQ0197	Insecta	Diptera Chironomidae	*Procladius sp.*	2	1	2	1				
WQ0197	Insecta	Diptera Chironomidae	*Rheotanytarsus sp.*		6						
WQ0197	Insecta	Diptera Chironomidae	*Tanytarsus sp.*		13	31		23.74%	15.18%	14.78%	12.12%
WQ0197	Insecta	Diptera Miscelaneous	*Atherix sp.*			22					
WQ0197	Insecta	Diptera Miscelaneous	*Palpomyia sp.*				8				
WQ0197	Insecta	Diptera Miscelaneous	Simuliidae unidentified		1						
WQ0197	Insecta	Diptera Miscelaneous	*Prosimulium sp.*				2				
WQ0197	Insecta	Diptera Miscelaneous	*Simulium sp.*	3	61	26	19				
WQ0197	Insecta	Diptera Miscelaneous	*Tipula sp.*	1		4	1	1.12%	10.46%	6.86%	9.09%
WQ0197	Insecta	Ephemeroptera	*Baetis sp.*	16	212	166	23				
WQ0197	Insecta	Ephemeroptera	*Caenis sp.*	51	1	96	20				
WQ0197	Insecta	Ephemeroptera	*Centroptilum sp.*		16	6					
WQ0197	Insecta	Ephemeroptera	*Hexagenia limbata*	1							
WQ0197	Insecta	Ephemeroptera	*Hexagenia sp.*			3					
WQ0197	Insecta	Ephemeroptera	*Leptophlebia sp.*	143	29	1	3				
WQ0197	Insecta	Ephemeroptera	*Paraleptophlebia sp.*		13	68	7				
WQ0197	Insecta	Ephemeroptera	*Pseudocloeon sp.*		31	90					
WQ0197	Insecta	Ephemeroptera	*Stenacron sp.*	18		7	31				
WQ0197	Insecta	Ephemeroptera	*Stenonema sp.*	5	12	3					
WQ0197	Insecta	Ephemeroptera	*Tricorythodes sp.*			1		65.36%	52.95%	58.18%	25.45%
WQ0197	Insecta	Hemiptera	Corixidae unidentified			12					
WQ0197	Insecta	Hemiptera	Hemiptera unidentified		1			0.00%	0.17%	1.58%	0.00%
WQ0197	Insecta	Megaloptera	*Sialis sp.*	1		4	2	0.28%	0.00%	0.53%	0.61%
WQ0197	Insecta	Neuroptera	*Climacia sp.*		2			0.00%	0.34%	0.00%	0.00%
WQ0197	Insecta	Odonata	*Calopteryx sp.*	1			1				
WQ0197	Insecta	Odonata	*Dromogomphus sp.*	1							
WQ0197	Insecta	Odonata	*Enallagma sp.*	1		4					
WQ0197	Insecta	Odonata	*Ophiogomphus sp.*				1	0.84%	0.00%	0.53%	0.61%
WQ0197	Insecta	Plecoptera	*Acroneuria arida*	1							
WQ0197	Insecta	Plecoptera	*Eccoptura sp.*			1		0.28%	0.00%	0.13%	0.00%
WQ0197	Insecta	Trichoptera	*Agraylea sp.*			1					
WQ0197	Insecta	Trichoptera	*Ceratopsyche sp.*	2							
WQ0197	Insecta	Trichoptera	*Cheumatopsyche sp.*	1		1	1				
WQ0197	Insecta	Trichoptera	*Helicopsyche sp.*		1						
WQ0197	Insecta	Trichoptera	*Hydropsyche sp.*		12	2	1				
WQ0197	Insecta	Trichoptera	*Hydroptila sp.*		5	4					
WQ0197	Insecta	Trichoptera	*Mystacides sp.*		1						
WQ0197	Insecta	Trichoptera	*Nectopsyche sp.*	1		1					
WQ0197	Insecta	Trichoptera	*Neureclipsis sp.*	1							
WQ0197	Insecta	Trichoptera	*Ochrotrichia sp.*	1							
WQ0197	Insecta	Trichoptera	*Polycentropus sp.*				1	1.68%	3.20%	1.19%	0.91%
WQ0197	Annelida	Hirudinea	*Batracobdella sp.*				1				
WQ0197	Annelida	Hirudinea	*Helobdella stagnalis*				1	0.00%	0.00%	0.00%	0.61%
WQ0197	Annelida	Oligochaeta	*Aeolosoma sp.*	10							
WQ0197	Annelida	Oligochaeta	*Dero sp.*				19				
WQ0197	Annelida	Oligochaeta	*Limnodrilus sp.*				15				
WQ0197	Annelida	Oligochaeta	*Nais sp.*			31	10				
WQ0197	Annelida	Oligochaeta	*Ophidonais serpentina*			6					
WQ0197	Annelida	Oligochaeta	*Pristina sp.*			3					
WQ0197	Annelida	Oligochaeta	Tubifex sp.				6	2.79%	0.00%	5.28%	15.15%
WQ0197	Porifera	Porifera	Porifera unidentified		1			0.00%	0.17%	0.00%	0.00%
WQ0197	Gastropoda	Ctenobranchiata	*Amincola limosa*		1	1	22				
WQ0197	Gastropoda	Ctenobranchiata	*Marstonia decepta*				1				
WQ0197	Gastropoda	Ctenobranchiata	*Valvata tricarinata*				2				
WQ0197	Gastropoda	Pulmonata	*Fernissia rivularis*	1							
WQ0197	Gastropoda	Pulmonata	*Fernissia sp.*		2	2	2				
WQ0197	Gastropoda	Pulmonata	*Gyraulus sp.*		2						
WQ0197	Gastropoda	Pulmonata	*Lymnaea sp.*			1					
WQ0197	Gastropoda	Pulmonata	*Physa sp.*			5	8	0.28%	0.84%	1.19%	10.61%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon 1995	1996	1997	1998	% Order or Subclass 1995	1996	1997	1998
WQ0197	**Whitemud River at Westbourne, total of 5 samples per site per year* (continued).**										
WQ0197	Pelecypoda	Sphaeriidae	*Pisidium sp.*	2	2	10	2				
WQ0197	Pelecypoda	Sphaeriidae	*Sphaerium simile*				26				
WQ0197	Pelecypoda	Sphaeriidae	*Sphaerium sp.*		3	2	38	0.56%	0.84%	1.58%	20.00%
WQ0197	**Total**			358	593	758	330	100.00%	100.00%	100.00%	100.00%
WQ0217	**North Duck River, PTH 10 at Cowan, total of 5 samples per site per year*.**										
WQ0217	Arachnoidae	Hydracarina	Hydracarina unidentified				1				
WQ0217	Arachnoidae	Hydracarina	*Arrenurus sp.*			3		0.00%	0.00%	1.32%	0.16%
WQ0217	Insecta	Coleoptera	*Dubiraphia sp.*	2		2					
WQ0217	Insecta	Coleoptera	*Optioservus sp.*	1				0.38%	0.00%	0.88%	0.00%
WQ0217	Insecta	Diptera Chironomidae	Chironomidae unidentified		1						
WQ0217	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*	2		1					
WQ0217	Insecta	Diptera Chironomidae	*Chironomus sp.*				23				
WQ0217	Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*			1					
WQ0217	Insecta	Diptera Chironomidae	*Cricotopus sp.*	1	1	1					
WQ0217	Insecta	Diptera Chironomidae	*Cryptotendipes sp.*			2					
WQ0217	Insecta	Diptera Chironomidae	*Microtendipes sp.*				2				
WQ0217	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*			1	1				
WQ0217	Insecta	Diptera Chironomidae	*Polypedilum sp.*	2	1	2	1				
WQ0217	Insecta	Diptera Chironomidae	*Procladius sp.*				2				
WQ0217	Insecta	Diptera Chironomidae	*Stenochironomus sp.*			1					
WQ0217	Insecta	Diptera Chironomidae	*Tanytarsus sp.*		1	6	1	0.63%	6.35%	6.61%	4.70%
WQ0217	Insecta	Diptera Miscelaneous	*Atherix sp.*	4							
WQ0217	Insecta	Diptera Miscelaneous	*Chrysops sp.*	10	2	3					
WQ0217	Insecta	Diptera Miscelaneous	*Hemerodromia sp.*	1							
WQ0217	Insecta	Diptera Miscelaneous	*Hexatoma sp.*		1						
WQ0217	Insecta	Diptera Miscelaneous	*Palpomyia sp.*	1			1	2.02%	4.76%	1.32%	0.16%
WQ0217	Insecta	Ephemeroptera	Ephemeroptera unidentified	1							
WQ0217	Insecta	Ephemeroptera	*Baetis sp.*		3	19					
WQ0217	Insecta	Ephemeroptera	*Baetisca lacustris*		4						
WQ0217	Insecta	Ephemeroptera	*Baetisca sp.*	15		14	7				
WQ0217	Insecta	Ephemeroptera	*Caenis sp.*	4		1	5				
WQ0217	Insecta	Ephemeroptera	*Callibaetis sp.*		1						
WQ0217	Insecta	Ephemeroptera	*Centroptilum sp.*			24	1				
WQ0217	Insecta	Ephemeroptera	*Ephemera sp*	8		1	1				
WQ0217	Insecta	Ephemeroptera	*Hexagenia sp.*			3					
WQ0217	Insecta	Ephemeroptera	*Leptophlebia sp.*	18			5				
WQ0217	Insecta	Ephemeroptera	*Paraleptophlebia sp.*		3	2	1				
WQ0217	Insecta	Ephemeroptera	*Pseudocloeon sp.*			2					
WQ0217	Insecta	Ephemeroptera	*Siphlopecton interlineatum*		1						
WQ0217	Insecta	Ephemeroptera	*Siphloplecton sp.*	10			1				
WQ0217	Insecta	Ephemeroptera	Stenacron sp.				2				
WQ0217	Insecta	Ephemeroptera	*Tricorythodes sp.*			1		7.18%	19.05%	29.52%	3.61%
WQ0217	Insecta	Hemiptera	Corixidae unidentified	532	41	124	528				
WQ0217	Insecta	Hemiptera	*Hesperocorixa sp.*	18							
WQ0217	Insecta	Hemiptera	*Palmacorixa sp.*			1					
WQ0217	Insecta	Hemiptera	*Sigara lineata*	58			21				
WQ0217	Insecta	Hemiptera	*Sigara sp.*	81		1	26				
WQ0217	Insecta	Hemiptera	*Sigara trilineata*	13				88.41%	65.08%	55.51%	90.13%
WQ0217	Insecta	Odonata	*Aeschna sp.*	1							
WQ0217	Insecta	Odonata	*Ophiogomphus sp.*	1		4		0.25%	0.00%	1.76%	0.00%
WQ0217	Insecta	Plecoptera	*Pteronarcys sp.*				2	0.00%	0.00%	0.00%	0.31%
WQ0217	Insecta	Trichoptera	*Cheumatopsyche sp.*	1							
WQ0217	Insecta	Trichoptera	*Hydatophylax sp.*	1							
WQ0217	Insecta	Trichoptera	*Hydropsyche sp.*	1	1						
WQ0217	Insecta	Trichoptera	*Triaenodes sp.*			3		0.38%	1.59%	1.32%	0.00%
WQ0217	Nematoda	Nematoda	Nematoda unidentified	1				0.13%	0.00%	0.00%	0.00%
WQ0217	Annelida	Hirudinea	*Helobdella stagnalis*				1	0.00%	0.00%	0.00%	0.16%
WQ0217	Annelida	Oligochaeta	*Aeolosoma sp.*		1						
WQ0217	Annelida	Oligochaeta	*Limnodrilus sp.*			1	1	0.00%	1.59%	0.44%	0.16%
WQ0217	Gastropoda	Ctenobranchiata	*Amincola limosa*	1		1	3				
WQ0217	Gastropoda	Pulmonata	*Helisoma anceps*			1					
WQ0217	Gastropoda	Pulmonata	*Physa sp.*	1				0.25%	0.00%	0.88%	0.47%
WQ0217	Pelecypoda	Sphaeriidae	*Pisidium sp.*			1					
WQ0217	Pelecypoda	Sphaeriidae	*Sphaerium sp.*	3	1		1	0.38%	1.59%	0.44%	0.16%
WQ0217	**Total**			794	63	227	638	100.00%	100.00%	100.00%	100.00%
WQ0220	**Sclater River, PTH 20 near Camperville, total of 5 samples per site per year*.**										
WQ0220	Arachnoidae	Hydracarina	*Hydrachna sp.*			4					
WQ0220	Arachnoidae	Hydracarina	*Hygrobates sp.*			2					
WQ0220	Arachnoidae	Hydracarina	*Sperchon sp.*			1		0.00%	0.00%	2.98%	0.00%
WQ0220	Crustacea	Amphipoda	*Gammarus sp.*		2						
WQ0220	Crustacea	Amphipoda	*Hyalella azteca*	48	126	35	49	32.39%	29.36%	14.89%	34.03%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon				% Order or Subclass			
				1995	1996	1997	1998	1995	1996	1997	1998
WQ0220	**Sclater River, PTH 20 near Camperville, total of 5 samples per site per year* (continued).**										
WQ0220	Crustacea	Decapoda	Cambaridae unidentified	2							
WQ0220	Crustacea	Decapoda	*Orconectes immunis*	1							
WQ0220	Crustacea	Decapoda	*Orconectes virilis*		18						
WQ0220	Crustacea	Decapoda	*Orconectes sp.*			3	2	2.11%	3.67%	1.28%	1.39%
WQ0220	Insecta	Coleoptera	*Dubiraphia sp.*		1	3					
WQ0220	Insecta	Coleoptera	*Gyrinus sp.*				1				
WQ0220	Insecta	Coleoptera	*Haliplus sp.*				1				
WQ0220	Insecta	Coleoptera	*Hydroporus sp.*	3							
WQ0220	Insecta	Coleoptera	*Optioservus sp.*			1					
WQ0220	Insecta	Coleoptera	*Stenelmis sp.*		1			2.11%	0.46%	1.70%	1.39%
WQ0220	Insecta	Diptera Chironomidae	Chironomidae unidentified			6					
WQ0220	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*		1	1					
WQ0220	Insecta	Diptera Chironomidae	*Chironomus sp.*	2							
WQ0220	Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*	4							
WQ0220	Insecta	Diptera Chironomidae	*Cricotopus sp.*	2	4	1					
WQ0220	Insecta	Diptera Chironomidae	*Dicrotendipes sp.*	14							
WQ0220	Insecta	Diptera Chironomidae	*Endochironomus sp.*	2							
WQ0220	Insecta	Diptera Chironomidae	*Labrundinia sp.*			1					
WQ0220	Insecta	Diptera Chironomidae	*Micropsectra sp.*		1						
WQ0220	Insecta	Diptera Chironomidae	*Microtendipes sp.*	1		3					
WQ0220	Insecta	Diptera Chironomidae	*Paramerina sp.*			1					
WQ0220	Insecta	Diptera Chironomidae	*Paratanytarsus sp.*		2						
WQ0220	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*	1							
WQ0220	Insecta	Diptera Chironomidae	*Polypedilum sp.*		14	1					
WQ0220	Insecta	Diptera Chironomidae	*Procladius sp.*	2			1				
WQ0220	Insecta	Diptera Chironomidae	*Pseudochironomus sp.*			1					
WQ0220	Insecta	Diptera Chironomidae	*Stenochironomus sp.*		1	3					
WQ0220	Insecta	Diptera Chironomidae	*Stictochironomus sp.*	1	12		4				
WQ0220	Insecta	Diptera Chironomidae	Tanypodinae unidentified		1						
WQ0220	Insecta	Diptera Chironomidae	*Tanytarsus sp.*	1		1		21.13%	8.26%	8.09%	3.47%
WQ0220	Insecta	Diptera Miscelaneous	Diptera Misc. unidentified		1						
WQ0220	Insecta	Diptera Miscelaneous	*Atherix sp.*	1							
WQ0220	Insecta	Diptera Miscelaneous	*Chrysops sp.*	2	1						
WQ0220	Insecta	Diptera Miscelaneous	*Dixa sp.*				1				
WQ0220	Insecta	Diptera Miscelaneous	*Palpomyia sp.*			1		2.11%	0.46%	0.43%	0.69%
WQ0220	Insecta	Ephemeroptera	*Baetis sp.*		107	4					
WQ0220	Insecta	Ephemeroptera	*Caenis sp.*	1	89	36					
WQ0220	Insecta	Ephemeroptera	*Callibaetis sp.*		24	56					
WQ0220	Insecta	Ephemeroptera	*Cloeon sp.*			14					
WQ0220	Insecta	Ephemeroptera	*Ephemera sp.*			1					
WQ0220	Insecta	Ephemeroptera	*Hexagenia sp.*			1					
WQ0220	Insecta	Ephemeroptera	*Leptophlebia sp.*		1						
WQ0220	Insecta	Ephemeroptera	*Paraleptophlebia sp.*			8					
WQ0220	Insecta	Ephemeroptera	*Stenacron sp.*		11	6		0.70%	53.21%	53.62%	0.00%
WQ0220	Insecta	Hemiptera	Corixidae unidentified				1				
WQ0220	Insecta	Hemiptera	*Dasycorixa hybrida*			1					
WQ0220	Insecta	Hemiptera	*Hesperocorixa sp.*	1			5				
WQ0220	Insecta	Hemiptera	*Sigara sp.*	8			1				
WQ0220	Insecta	Hemiptera	*Trichocorixa borealis*				10				
WQ0220	Insecta	Hemiptera	*Trichocorixa naias*	1			3	7.04%	0.00%	0.43%	13.89%
WQ0220	Insecta	Megaloptera	*Sialis sp.*				1	0.00%	0.00%	0.00%	0.69%
WQ0220	Insecta	Odonata	*Aeschna sp.*	1	1						
WQ0220	Insecta	Odonata	*Calopteryx sp.*			6					
WQ0220	Insecta	Odonata	*Enallagma sp.*	42	1	12	62				
WQ0220	Insecta	Odonata	*Tetragoneuria sp.*				1	30.28%	0.46%	7.66%	43.75%
WQ0220	Insecta	Plecoptera	*Eccoptura sp.*		1			0.00%	0.23%	0.00%	0.00%
WQ0220	Insecta	Trichoptera	*Hydropsyche sp.*		4						
WQ0220	Insecta	Trichoptera	*Hydroptila sp.*		2						
WQ0220	Insecta	Trichoptera	*Oecetis sp.*	1							
WQ0220	Insecta	Trichoptera	*Polycentropus sp.*		3						
WQ0220	Insecta	Trichoptera	*Triaenodes sp.*		1			0.70%	2.29%	0.00%	0.00%
WQ0220	Coelenterata	Coelenterata	*Hydra sp.*			1		0.00%	0.00%	0.43%	0.00%
WQ0220	Annelida	Oligochaeta	*Nais sp.*			1		0.00%	0.00%	0.43%	0.00%
WQ0220	Gastropoda	Ctenobranchiata	*Amnicola limosa*		1	4					
WQ0220	Gastropoda	Ctenobranchiata	*Cincinnatia cincinnatiensis*			3					
WQ0220	Gastropoda	Ctenobranchiata	*Valvata sincera*		1						
WQ0220	Gastropoda	Ctenobranchiata	*Valvata tricaninata*	1	3	2	1				
WQ0220	Gastropoda	Pulmonata	*Armiger crista*		1						
WQ0220	Gastropoda	Pulmonata	*Ferrissia sp.*			7					
WQ0220	Gastropoda	Pulmonata	*Gyraulus sp.*	1	1	1					
WQ0220	Gastropoda	Pulmonata	*Physa sp.*			2		1.41%	1.61%	8.09%	0.69%
WQ0220	**Total**			**142**	**436**	**235**	**144**	100.00%	100.00%	100.00%	100.00%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon				% Order or Subclass			
				1995	1996	1997	1998	1995	1996	1997	1998
WQ0223	**Fishing River, PTH 20 at town of Fishing River, total of 5 samples per site per year*.**										
WQ0223	Arachnoidae	Hydracarina	*Arrenurus sp.*				1	0.00%	0.00%	0.00%	0.52%
WQ0223	Crustacea	Amphipoda	*Hyalella azteca*	7	6	11	31	1.79%	14.29%	13.41%	16.15%
WQ0223	Crustacea	Decapoda	*Orconectes virilis*		2			0.00%	4.76%	0.00%	0.00%
WQ0223	Insecta	Coleoptera	*Dubiraphia sp.*	3	1	5		0.77%	2.38%	6.10%	0.00%
WQ0223	Insecta	Diptera Chironomidae	Chironomidae unidentified		1	3	1				
WQ0223	Insecta	Diptera Chironomidae	*Chironomus sp.*	29							
WQ0223	Insecta	Diptera Chironomidae	*Cricotopus sp.*			2					
WQ0223	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*	2							
WQ0223	Insecta	Diptera Chironomidae	*Cryptotendipes sp.*			1					
WQ0223	Insecta	Diptera Chironomidae	*Dicrotendipes sp.*	21							
WQ0223	Insecta	Diptera Chironomidae	*Endochironomus sp.*	2							
WQ0223	Insecta	Diptera Chironomidae	*Microtendipes sp.*	2							
WQ0223	Insecta	Diptera Chironomidae	*Paracladopelma sp.*			1					
WQ0223	Insecta	Diptera Chironomidae	*Paratanytarsus sp.*				1				
WQ0223	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*	2							
WQ0223	Insecta	Diptera Chironomidae	*Polypedilium sp.*			1					
WQ0223	Insecta	Diptera Chironomidae	*Procladius sp.*	39							
WQ0223	Insecta	Diptera Chironomidae	*Pseudochironomus sp.*		1	1					
WQ0223	Insecta	Diptera Chironomidae	*Stenochironomus sp.*			2	1				
WQ0223	Insecta	Diptera Chironomidae	*Stictochironomus sp.*	2				25.26%	4.76%	13.41%	1.56%
WQ0223	Insecta	Diptera Miscelaneous	*Chrysops sp.*	1							
WQ0223	Insecta	Diptera Miscelaneous	*Palpomyia sp.*	2				0.77%	0.00%	0.00%	0.00%
WQ0223	Insecta	Ephemeroptera	Ephemeroptera unidentified		1						
WQ0223	Insecta	Ephemeroptera	Baetidae unidentified				2				
WQ0223	Insecta	Ephemeroptera	*Baetis sp.*	4	2	2					
WQ0223	Insecta	Ephemeroptera	*Caenis sp.*	49	6	16	17				
WQ0223	Insecta	Ephemeroptera	*Callibaetis sp.*			4	1				
WQ0223	Insecta	Ephemeroptera	*Centroptilium sp.*				4				
WQ0223	Insecta	Ephemeroptera	*Leptophlebia sp.*	5			23				
WQ0223	Insecta	Ephemeroptera	*Paraleptophlebia sp.*			5	30				
WQ0223	Insecta	Ephemeroptera	*Stenacron sp.*	4		19	69	15.82%	21.43%	56.10%	76.04%
WQ0223	Insecta	Hemiptera	Corixidae unidentified	2			7				
WQ0223	Insecta	Hemiptera	*Hesperocorixa sp.*	6							
WQ0223	Insecta	Hemiptera	*Sigara lineata*	1							
WQ0223	Insecta	Hemiptera	*Sigara sp.*	17							
WQ0223	Insecta	Hemiptera	*Sigara trilineata*	29				14.03%	0.00%	0.00%	3.65%
WQ0223	Insecta	Odonata	*Calopteryx sp.*			1					
WQ0223	Insecta	Odonata	*Enallagma sp.*	1				0.26%	0.00%	1.22%	0.00%
WQ0223	Insecta	Trichoptera	Trichoptera unidentified				1				
WQ0223	Insecta	Trichoptera	*Cheumatopsyche sp.*			2					
WQ0223	Insecta	Trichoptera	*Helicopsyche sp.*			1					
WQ0223	Insecta	Trichoptera	*Hydatophylax sp.*				1				
WQ0223	Insecta	Trichoptera	*Hydropsyche sp.*			2					
WQ0223	Insecta	Trichoptera	*Nectopsyche sp.*				1				
WQ0223	Insecta	Trichoptera	*Oecetis sp.*			1					
WQ0223	Insecta	Trichoptera	*Ptilostomis sp.*	8	1			2.04%	2.38%	7.32%	1.56%
WQ0223	Annelida	Hirudinea	*Helobdella stagnalis*	1	1			0.26%	2.38%	0.00%	0.00%
WQ0223	Gastropoda	Ctenobranchiata	*Amnicola limosa*	121	10						
WQ0223	Gastropoda	Ctenobranchiata	*Amnicola sp.*		4						
WQ0223	Gastropoda	Ctenobranchiata	*Marstonia decepta*		1						
WQ0223	Gastropoda	Ctenobranchiata	*Valvata sincera*	2							
WQ0223	Gastropoda	Ctenobranchiata	*Valvata tricaninata*	16							
WQ0223	Gastropoda	Pulmonata	*Ferrissia rivularis*	1	1						
WQ0223	Gastropoda	Pulmonata	*Ferrissia sp.*			2	1				
WQ0223	Gastropoda	Pulmonata	*Gyraulus sp.*	11	1						
WQ0223	Gastropoda	Pulmonata	*Helisoma sp.*		1						
WQ0223	Gastropoda	Pulmonata	*Lymnaea sp.*	1							
WQ0223	Gastropoda	Pulmonata	*Physa sp.*	1				39.03%	42.86%	2.44%	0.52%
WQ0223	Pelecypoda	Sphaeriidae	*Pisidium sp.*		1						
WQ0223	Pelecypoda	Unionidae	*Anodontoides ferussacianus*		1			0.00%	4.76%	0.00%	0.00%
WQ0223	**Total**			392	42	82	192	100.00%	100.00%	100.00%	100.00%
WQ0226	**Mossy River, PR 364 south of town of Winnipegosis, total of 5 samples per site per year*.**										
WQ0226	Crustacea	Amphipoda	*Hyalella azteca*	143	32	89	24	38.54%	9.38%	23.71%	9.45%
WQ0226	Crustacea	Decapoda	*Orconectes virilis*		2						
WQ0226	Crustacea	Decapoda	*Orconectes immunis*	4							
WQ0226	Crustacea	Decapoda	*Orconectes sp.*			1		1.08%	0.59%	0.34%	0.00%
WQ0226	Insecta	Coleoptera	*Dubiraphia sp.*	5	4	9	8				
WQ0226	Insecta	Coleoptera	Liodessus affinis				2	1.35%	1.17%	3.09%	3.94%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon				% Order or Subclass			
				1995	1996	1997	1998	1995	1996	1997	1998
WQ0226	**Mossy River, PR 364 south of town of Winnipegosis, total of 5 samples per site per year* (continued).**										
WQ0226	Insecta	Diptera Chironomidae	Chironomidae unidentified		4		1				
WQ0226	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*	3	17	1					
WQ0226	Insecta	Diptera Chironomidae	*Chironomus sp.*		3	4	6				
WQ0226	Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*		1						
WQ0226	Insecta	Diptera Chironomidae	*Clinotanypus sp.*				2				
WQ0226	Insecta	Diptera Chironomidae	*Cricotopus sp.*			1	1				
WQ0226	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*	2							
WQ0226	Insecta	Diptera Chironomidae	*Cryptotendipes sp.*			3					
WQ0226	Insecta	Diptera Chironomidae	*Demicryptochironomus sp.*		1						
WQ0226	Insecta	Diptera Chironomidae	*Dicrotendipes sp.*			1					
WQ0226	Insecta	Diptera Chironomidae	*Endochironomus sp.*				10				
WQ0226	Insecta	Diptera Chironomidae	*Epoicocladius sp.*		1	4					
WQ0226	Insecta	Diptera Chironomidae	*Glyptotendipes sp.*		2	1					
WQ0226	Insecta	Diptera Chironomidae	*Microtendipes sp.*	2	1						
WQ0226	Insecta	Diptera Chironomidae	*Paramerina sp.*		1	2					
WQ0226	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*	3	75	2					
WQ0226	Insecta	Diptera Chironomidae	*Polypedilum sp.*		7		2				
WQ0226	Insecta	Diptera Chironomidae	*Procladius sp.*	1	19	8	2				
WQ0226	Insecta	Diptera Chironomidae	*Rheotanytarsus sp.*		6	1					
WQ0226	Insecta	Diptera Chironomidae	*Tanytarsus sp.*			7	2	2.96%	40.47%	12.03%	10.24%
WQ0226	Insecta	Diptera Miscelaneous	*Hemerodromia sp.*	5							
WQ0226	Insecta	Diptera Miscelaneous	*Palpomyia sp.*		5	1	2				
WQ0226	Insecta	Diptera Miscelaneous	*Simulium sp.*	1				1.62%	1.47%	0.34%	0.79%
WQ0226	Insecta	Ephemeroptera	Ephemeroptera unidentified		1						
WQ0226	Insecta	Ephemeroptera	*Baetis sp.*	6	2	1	1				
WQ0226	Insecta	Ephemeroptera	*Caenis sp.*	2	2	14	5				
WQ0226	Insecta	Ephemeroptera	*Callibaetis sp.*			4	7				
WQ0226	Insecta	Ephemeroptera	*Centroptilum sp.*			10					
WQ0226	Insecta	Ephemeroptera	*Ephemera sp.*			2	1				
WQ0226	Insecta	Ephemeroptera	*Hexagenia limbata*	9	72	75	59				
WQ0226	Insecta	Ephemeroptera	*Leptophlebia sp.*	6			1				
WQ0226	Insecta	Ephemeroptera	*Stenacron sp.*	91							
WQ0226	Insecta	Ephemeroptera	*Stenonema sp.*	26		13	38	37.74%	22.58%	40.89%	44.09%
WQ0226	Insecta	Hemiptera	Corixidae unidentified	1		6	10				
WQ0226	Insecta	Hemiptera	*Calliconixa sp.*				1				
WQ0226	Insecta	Hemiptera	*Palmaconixa sp.*				1				
WQ0226	Insecta	Hemiptera	*Hesperoconixa sp.*	2							
WQ0226	Insecta	Hemiptera	*Sigara sp.*	1			11				
WQ0226	Insecta	Hemiptera	*Trichocorixa borealis*			2	23				
WQ0226	Insecta	Hemiptera	*Trichocorixa naias*			1					
WQ0226	Insecta	Hemiptera	*Trichocorixa sp.*	1				1.35%	0.00%	3.09%	18.11%
WQ0226	Insecta	Megaloptera	*Sialis sp.*	2	9	2	2	0.54%	2.64%	0.69%	0.79%
WQ0226	Insecta	Odonata	*Dromogomphus sp.*		1						
WQ0226	Insecta	Odonata	*Enallagma sp.*	3		1		0.81%	0.29%	0.34%	0.00%
WQ0226	Insecta	Trichoptera	*Cheumatopsyche sp.*	14	4						
WQ0226	Insecta	Trichoptera	*Helicopsyche sp.*	3			4				
WQ0226	Insecta	Trichoptera	*Hydatophylax sp.*	1			1				
WQ0226	Insecta	Trichoptera	*Hydropsyche sp.*	7	2						
WQ0226	Insecta	Trichoptera	*Hydroptila sp.*				2				
WQ0226	Insecta	Trichoptera	*Nectopsyche sp.*				2				
WQ0226	Insecta	Trichoptera	*Neureclipsis sp.*		1						
WQ0226	Insecta	Trichoptera	*Ptilostomis sp.*		1			6.74%	2.35%	0.00%	3.54%
WQ0226	Nematomorph	Nematomorpha	Nematomorpha unidentified			1	1	0.00%	0.00%	0.34%	0.39%
WQ0226	Annelida	Hirudinea	*Dina sp.*	2							
WQ0226	Annelida	Hirudinea	*Erpobdella punctata*		2						
WQ0226	Annelida	Hirudinea	*Placobdella sp.*		1			0.54%	0.88%	0.00%	0.00%
WQ0226	Annelida	Oligochaeta	*Limnodrilus sp.*			1		0.00%	0.00%	0.34%	0.00%
WQ0226	Gastropoda	Ctenobranchiata	*Amnicola limosa*	14	44	32	14				
WQ0226	Gastropoda	Ctenobranchiata	*Marstonia decepta*		1						
WQ0226	Gastropoda	Ctenobranchiata	*Valvata sincera*		2						
WQ0226	Gastropoda	Pulmonata	*Fernssia sp.*			5	5				
WQ0226	Gastropoda	Pulmonata	*Lymnaea sp.*		1						
WQ0226	Gastropoda	Pulmonata	*Physa sp.*	5			2	5.12%	14.08%	12.71%	8.27%
WQ0226	Pelecypoda	Sphaeriidae	*Pisidium sp.*	1	13	5	1				
WQ0226	Pelecypoda	Sphaeriidae	*Sphaerium sp.*	5	1	1		1.62%	4.11%	2.06%	0.39%
WQ0226	**Total**			371	341	291	254	100.00%	100.00%	100.00%	100.00%
WQ0227	**Ochre River, PTH 5 near town of Ochre River, total of 5 samples per site per year*.**										
WQ0227	Arachnoidae	Hydracanna	*Lebertia sp.*				1	0.00%	0.00%	0.00%	0.56%
WQ0227	Crustacea	Amphipoda	*Hyalella azteca*				3	0.00%	0.00%	0.00%	1.69%
WQ0227	Crustacea	Decapoda	*Orconectes virilis*			1					
WQ0227	Crustacea	Decapoda	*Orconectes sp.*			1	14	0.00%	0.00%	0.75%	7.87%
WQ0227	Insecta	Coleoptera	*Dubiraphia sp.*	2	1						
WQ0227	Insecta	Coleoptera	*Liodessus affinis*				2	3.13%	1.01%	0.00%	1.12%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon				% Order or Subclass			
				1995	1996	1997	1998	1995	1996	1997	1998
WQ0227	**Ochre River, PTH 5 near town of Ochre River, total of 5 samples per site per year* (continued).**										
WQ0227	Insecta	Diptera Chironomidae	Chironomidae unidentified			1					
WQ0227	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*		1		1				
WQ0227	Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*			3	2				
WQ0227	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*		1	10					
WQ0227	Insecta	Diptera Chironomidae	*Dicrotendipes sp.*			1	1				
WQ0227	Insecta	Diptera Chironomidae	*Microtendipes sp.*	1			4				
WQ0227	Insecta	Diptera Chironomidae	*Parachironomus sp.*	1							
WQ0227	Insecta	Diptera Chironomidae	*Polypedilum sp.*			1					
WQ0227	Insecta	Diptera Chironomidae	*Procladius sp.*	1		2					
WQ0227	Insecta	Diptera Chironomidae	*Pseudochironomus sp.*			1					
WQ0227	Insecta	Diptera Chironomidae	*Rheotanytarsus sp.*		2						
WQ0227	Insecta	Diptera Chironomidae	*Stenochironomus sp.*			19					
WQ0227	Insecta	Diptera Chironomidae	*Stictochironomus sp.*	1	4						
WQ0227	Insecta	Diptera Chironomidae	*Tanytarsus sp.*			2	2	6.25%	8.08%	14.93%	5.62%
WQ0227	Insecta	Diptera Miscelaneous	*Eriocera sp.*		2						
WQ0227	Insecta	Diptera Miscelaneous	*Hemerodromia sp.*	1							
WQ0227	Insecta	Diptera Miscelaneous	*Palpomyia sp.*		2	1	1	1.56%	4.04%	0.37%	0.56%
WQ0227	Insecta	Ephemeroptera	Ephemeroptera unidentified	2	2						
WQ0227	Insecta	Ephemeroptera	*Baetis sp.*	2			14				
WQ0227	Insecta	Ephemeroptera	*Baetisca lacustris*		3						
WQ0227	Insecta	Ephemeroptera	*Baetisca sp.*	3		21	4				
WQ0227	Insecta	Ephemeroptera	*Caenis sp.*	31	12	12	22				
WQ0227	Insecta	Ephemeroptera	*Centroptilum sp.*			6					
WQ0227	Insecta	Ephemeroptera	*Cloeon sp.*		6						
WQ0227	Insecta	Ephemeroptera	*Ephemera simulans*	2	50						
WQ0227	Insecta	Ephemeroptera	*Ephemera sp.*			3	1				
WQ0227	Insecta	Ephemeroptera	*Hexagenia limbata*	6	1		2				
WQ0227	Insecta	Ephemeroptera	*Hexagenia sp.*			25					
WQ0227	Insecta	Ephemeroptera	*Leptophlebia sp.*	5		1	3				
WQ0227	Insecta	Ephemeroptera	*Paraleptophlebia sp.*				1				
WQ0227	Insecta	Ephemeroptera	*Pseudocloeon sp.*				1				
WQ0227	Insecta	Ephemeroptera	*Stenacron sp.*		1	1	36				
WQ0227	Insecta	Ephemeroptera	*Stenonema sp.*		1		2	79.69%	76.77%	25.75%	48.31%
WQ0227	Insecta	Hemiptera	Corixidae unidentified			124	1				
WQ0227	Insecta	Hemiptera	*Palmacorixa gillettei*			5					
WQ0227	Insecta	Hemiptera	*Palmacorixa sp.*		1	1					
WQ0227	Insecta	Hemiptera	*Sigara sp.*	1				1.56%	1.01%	48.51%	0.56%
WQ0227	Insecta	Megaloptera	*Sialis sp.*			1	3	0.00%	0.00%	0.37%	1.69%
WQ0227	Insecta	Odonata	*Dromogomphus sp.*	3	5			4.69%	5.05%	0.00%	0.00%
WQ0227	Insecta	Plecoptera	*Acroneuria sp.*		1		1				
WQ0227	Insecta	Plecoptera	***Eccoptura sp.***				1				
WQ0227	Insecta	Plecoptera	*Isoperla sp.*				1	0.00%	1.01%	0.00%	1.69%
WQ0227	Insecta	Trichoptera	*Brachycentrus sp.*	1							
WQ0227	Insecta	Trichoptera	*Cheumatopsyche sp.*				1				
WQ0227	Insecta	Trichoptera	*Helicopsyche sp.*		1		1				
WQ0227	Insecta	Trichoptera	*Hydropsyche sp.*				3				
WQ0227	Insecta	Trichoptera	*Hydroptila sp.*		1						
WQ0227	Insecta	Trichoptera	Nectopsyche sp.				2				
WQ0227	Insecta	Trichoptera	*Oecetis sp.*	1				3.13%	2.02%	0.00%	3.93%
WQ0227	Annelida	Branchiobdellida	*Cambarincola sp.*			14	46	0.00%	0.00%	5.22%	25.84%
WQ0227	Annelida	Oligochaeta	*Tubifex sp.*			4		0.00%	0.00%	1.49%	0.00%
WQ0227	Gastropoda	Pulmonata	*Valvata sincera*		1						
WQ0227	Gastropoda	Pulmonata	*Ferrissia sp.*			1	1	0.00%	1.01%	0.37%	0.56%
WQ0227	Pelecypoda	Sphaeriidae	Pisidium sp.			3					
WQ0227	Pelecypoda	Sphaeriidae	Sphaerium sp.			3		0.00%	0.00%	2.24%	0.00%
WQ0227	**Total**			**64**	**99**	**268**	**178**	100.00%	100.00%	100.00%	100.00%
WQ0233	**Pine River, PTH 20 @ Camperville, total of 5 samples per site per year*.**										
WQ0233	Arachnoidae	Hydracarina	*Arrenurus sp.*				3				
WQ0233	Arachnoidae	Hydracarina	*Hygrobates sp.*				1				
WQ0233	Arachnoidae	Hydracarina	*Mideopsis sp.*				1				
WQ0233	Arachnoidae	Hydracarina	*Unionicola sp.*			2		0.00%	0.00%	0.64%	0.70%
WQ0233	Crustacea	Amphipoda	*Hyalella azteca*	56	12	44	82	19.18%	6.74%	14.15%	11.42%
WQ0233	Crustacea	Decapoda	*Orconectes immunis*	1							
WQ0233	Crustacea	Decapoda	*Orconectes sp.*			1	2	0.34%	0.00%	0.32%	0.28%
WQ0233	Insecta	Coleoptera	*Dubiraphia sp.*	29	12	14	7				
WQ0233	Insecta	Coleoptera	*Haliplus sp.*			1	3				
WQ0233	Insecta	Coleoptera	*Hydroporus sp.*	1							
WQ0233	Insecta	Coleoptera	*Optioservus sp.*				1				
WQ0233	Insecta	Coleoptera	*Peltodytes edentulus*				1				
WQ0233	Insecta	Coleoptera	*Peltodytes sp.*				1				
WQ0233	Insecta	Coleoptera	*Stenelmis sp.*			1		10.27%	6.74%	5.14%	1.81%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon 1995	1996	1997	1998	% Order or Subclass 1995	1996	1997	1998
WQ0233	**Pine River, PTH 20 @ Camperville, total of 5 samples per site per year*.**										
WQ0233	Insecta	Diptera Chironomidae	Chironomidae unidentified	1			5				
WQ0233	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*			6	6				
WQ0233	Insecta	Diptera Chironomidae	*Chironomus sp.*		37		3				
WQ0233	Insecta	Diptera Chironomidae	*Cladopelma sp.*				2				
WQ0233	Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*			5	2				
WQ0233	Insecta	Diptera Chironomidae	*Cricotopus sp.*		2		8				
WQ0233	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*		2	2	2				
WQ0233	Insecta	Diptera Chironomidae	*Cryptotendipes sp.*		10	3					
WQ0233	Insecta	Diptera Chironomidae	*Dicrotendipes sp.*	3	3	3	11				
WQ0233	Insecta	Diptera Chironomidae	*Endochironomus sp.*				1				
WQ0233	Insecta	Diptera Chironomidae	*Epoicocladius sp.*	1	1		11				
WQ0233	Insecta	Diptera Chironomidae	*Glyptotendipes sp.*	4	2	9					
WQ0233	Insecta	Diptera Chironomidae	*Isocladius sp.*				3				
WQ0233	Insecta	Diptera Chironomidae	*Microtendipes sp.*	2	1	2	4				
WQ0233	Insecta	Diptera Chironomidae	*Paralauterborniella sp.*		1						
WQ0233	Insecta	Diptera Chironomidae	*Paramerina sp.*	1	1						
WQ0233	Insecta	Diptera Chironomidae	*Paratanytarsus sp.*				3				
WQ0233	Insecta	Diptera Chironomidae	*Paratendipes sp.*			4	35				
WQ0233	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*	5		2	14				
WQ0233	Insecta	Diptera Chironomidae	*Polypedilum sp.*		3	2					
WQ0233	Insecta	Diptera Chironomidae	*Procladius sp.*	22	6	19	87				
WQ0233	Insecta	Diptera Chironomidae	*Pseudochironomus sp.*			1					
WQ0233	Insecta	Diptera Chironomidae	*Rheotanytarsus sp.*		3						
WQ0233	Insecta	Diptera Chironomidae	*Tanypus sp.*		1						
WQ0233	Insecta	Diptera Chironomidae	*Tanytarsus sp.*	5	21	4	2				
WQ0233	Insecta	Diptera Chironomidae	*Thienemannimyia sp.*		1			15.07%	53.37%	19.94%	27.58%
WQ0233	Insecta	Diptera Miscelaneous	Diptera Misc. unidentified		6	3					
WQ0233	Insecta	Diptera Miscelaneous	*Allusudomyia sp.*			1					
WQ0233	Insecta	Diptera Miscelaneous	*Chrysops sp.*			3	1				
WQ0233	Insecta	Diptera Miscelaneous	*Lispocephelas sp.*	1							
WQ0233	Insecta	Diptera Miscelaneous	*Palpomyia sp.*		1	3	8	0.34%	3.93%	3.22%	1.25%
WQ0233	Insecta	Ephemeroptera	Ephemeroptera unidentified		2						
WQ0233	Insecta	Ephemeroptera	*Baetis sp.*	1							
WQ0233	Insecta	Ephemeroptera	*Caenis sp.*	12	2	64	56				
WQ0233	Insecta	Ephemeroptera	*Callibaetis sp.*	2		3	43				
WQ0233	Insecta	Ephemeroptera	*Cloeon sp.*		2						
WQ0233	Insecta	Ephemeroptera	*Ephemera sp.*	1			2				
WQ0233	Insecta	Ephemeroptera	*Hexagenia limbata*	3			12				
WQ0233	Insecta	Ephemeroptera	*Hexagenia rigida*		13						
WQ0233	Insecta	Ephemeroptera	*Paraleptophlebia sp.*				1				
WQ0233	Insecta	Ephemeroptera	*Stenacron sp.*	2			1	7.19%	10.67%	21.54%	16.02%
WQ0233	Insecta	Hemiptera	Corixidae unidentified			3	1				
WQ0233	Insecta	Hemiptera	*Cenocorixa sp.*				1				
WQ0233	Insecta	Hemiptera	*Hesperocorixa sp.*	1			1				
WQ0233	Insecta	Hemiptera	*Ranatra fusca*				1				
WQ0233	Insecta	Hemiptera	*Sigara trilineata*	6							
WQ0233	Insecta	Hemiptera	*Sigara sp.*	26			36				
WQ0233	Insecta	Hemiptera	*Trichocorixa borealis*			2	32				
WQ0233	Insecta	Hemiptera	*Trichocorixa verticalis*			1		11.30%	0.00%	1.93%	10.03%
WQ0233	Insecta	Megaloptera	*Sialis sp.*	1		1		0.34%	0.00%	0.32%	0.00%
WQ0233	Insecta	Odonata	*Basiaeschna sp.*	1							
WQ0233	Insecta	Odonata	*Boyeria sp.*			3					
WQ0233	Insecta	Odonata	*Calopteryx sp.*	1							
WQ0233	Insecta	Odonata	*Enallagma sp.*	46	28	41	130				
WQ0233	Insecta	Odonata	*Ischnura sp.*				4	16.44%	15.73%	14.15%	18.66%
WQ0233	Insecta	Plecoptera	*Taeniopteryx sp.*	1				0.34%	0.00%	0.00%	0.00%
WQ0233	Insecta	Trichoptera	*Agraylea sp.*	1							
WQ0233	Insecta	Trichoptera	*Hydatophylax sp.*	1							
WQ0233	Insecta	Trichoptera	*Hydroptila sp.*	1							
WQ0233	Insecta	Trichoptera	*Neureclipsis sp.*	4							
WQ0233	Insecta	Trichoptera	*Phryganea sp.*			1					
WQ0233	Insecta	Trichoptera	*Polycentropus sp.*	14		1		7.19%	0.00%	0.64%	0.00%
WQ0233	Bryozoa	Bryozoa	Bryozoa		1			0.00%	0.56%	0.00%	0.00%
WQ0233	Coelenterata	Coelenterata	*Hydra sp.*			1		0.00%	0.00%	0.32%	0.00%
WQ0233	Annelida	Hirudinea	*Glossiphonia complanata*			1		0.00%	0.00%	0.32%	0.00%
WQ0233	Annelida	Oligochaeta	*Aeolosoma sp.*		2						
WQ0233	Annelida	Oligochaeta	*Nais sp.*			5	6				
WQ0233	Annelida	Oligochaeta	*Pristina sp.*			6					
WQ0233	Annelida	Oligochaeta	*Stylaria lacustris*	3			9	1.03%	1.12%	3.54%	2.09%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon				% Order or Subclass			
				1995	1996	1997	1998	1995	1996	1997	1998
WQ0233	**Pine River, PTH 20 @ Campervile, total of 5 samples per site per year* (continued).**										
WQ0233	Gastropoda	Clenobranchiata	*Amincola limosa*	7		12	8				
WQ0233	Gastropoda	Clenobranchiata	*Cincinnatia cincinnatiensis*				6				
WQ0233	Gastropoda	Clenobranchiata	*Marstonia decepta*			1					
WQ0233	Gastropoda	Clenobranchiata	*Valvata tricarinata*				2				
WQ0233	Gastropoda	Pulmonata	*Ferrissia rivularis*	3							
WQ0233	Gastropoda	Pulmonata	*Ferrissia sp.*			6	7				
WQ0233	Gastropoda	Pulmonata	*Gyraulus sp.*	1		2	4				
WQ0233	Gastropoda	Pulmonata	*Physa sp.*	20	2	22	46	10.62%	1.12%	13.83%	10.17%
WQ0233	Pelecypoda	Sphaeriidae	*Pisidium sp.*	1				0.34%	0.00%	0.00%	0.00%
WQ0233	**Total**			292	178	311	718	100.00%	100.00%	100.00%	100.00%
WQ0244	**Swan River, PR 268 at Lenswood, total of 5 samples per site per year*.**										
WQ0244	Insecta	Coleoptera	*Dubiraphia sp.*		1						
WQ0244	Insecta	Coleoptera	*Hygrotus sp.*				1	0.00%	2.44%	0.00%	0.78%
WQ0244	Insecta	Diptera Chironomidae	Chironomidae unidentified		2	1	6				
WQ0244	Insecta	Diptera Chironomidae	*Chironomus sp.*				8				
WQ0244	Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*			11					
WQ0244	Insecta	Diptera Chironomidae	*Cricotopus sp.*			5					
WQ0244	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*			1	1				
WQ0244	Insecta	Diptera Chironomidae	*Microtendipes sp.*			1					
WQ0244	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*				2				
WQ0244	Insecta	Diptera Chironomidae	*Polypedilum sp.*		1	1					
WQ0244	Insecta	Diptera Chironomidae	*Procladius sp.*				1				
WQ0244	Insecta	Diptera Chironomidae	*Robackia sp.*				2				
WQ0244	Insecta	Diptera Chironomidae	*Stictochironomus sp.*		1						
WQ0244	Insecta	Diptera Chironomidae	*Tanytarsus sp.*			11	4	0.00%	9.76%	20.39%	18.75%
WQ0244	Insecta	Diptera Miscelaneous	*Eriocera sp.*	7	8						
WQ0244	Insecta	Diptera Miscelaneous	*Hexatoma sp.*			6					
WQ0244	Insecta	Diptera Miscelaneous	*Palpomyia sp.*	1			2	12.50%	19.51%	3.95%	1.56%
WQ0244	Insecta	Ephemeroptera	*Baetis sp.*		1	4					
WQ0244	Insecta	Ephemeroptera	*Baetisca lacustris*		1						
WQ0244	Insecta	Ephemeroptera	*Baetisca sp.*	32		24	4				
WQ0244	Insecta	Ephemeroptera	*Caenis sp.*	1	2	3	6				
WQ0244	Insecta	Ephemeroptera	*Callibaetis sp.*			4	1				
WQ0244	Insecta	Ephemeroptera	*Centroptilum sp.*			4					
WQ0244	Insecta	Ephemeroptera	*Ephemera sp.*			3					
WQ0244	Insecta	Ephemeroptera	*Heterocloeon sp.*			1					
WQ0244	Insecta	Ephemeroptera	*Hexagenia limbata*		9						
WQ0244	Insecta	Ephemeroptera	*Hexagenia sp.*			28	41				
WQ0244	Insecta	Ephemeroptera	*Leptophlebia sp.*				2				
WQ0244	Insecta	Ephemeroptera	*Paraleptophlebia sp.*			1	1				
WQ0244	Insecta	Ephemeroptera	*Pseudocloeon sp.*			10					
WQ0244	Insecta	Ephemeroptera	*Stenonema sp.*	5	4	20	9	59.38%	41.46%	67.11%	50.00%
WQ0244	Insecta	Hemiptera	Corixidae unidentified				1	0.00%	0.00%	0.00%	0.78%
WQ0244	Insecta	Odonata	*Dromogomphus sp.*	4	4	7	2				
WQ0244	Insecta	Odonata	*Ophiogomphus sp.*				10				
WQ0244	Insecta	Odonata	*Stylurus sp.*				1	6.25%	9.76%	4.61%	10.16%
WQ0244	Insecta	Plecoptera	Plecoptera unidentified				1				
WQ0244	Insecta	Plecoptera	*Taeniopteryx sp.*	3				4.69%	0.00%	0.00%	0.78%
WQ0244	Insecta	Trichoptera	*Cheumatopsyche sp.*			3					
WQ0244	Insecta	Trichoptera	*Hydropsyche sp.*	8	1	2					
WQ0244	Insecta	Trichoptera	*Nectopsyche sp.*				22	12.50%	2.44%	3.29%	17.19%
WQ0244	Gastropoda	Pulmonata	*Amincola limosa*	2		1		3.13%	0.00%	0.66%	0.00%
WQ0244	Pelecypoda	Sphaeriidae	*Sphaerium sp.*		5						
WQ0244	Pelecypoda	Unionidae	Unionidae unidentified		1						
WQ0244	Pelecypoda	Unionidae	*Lampsilis ovata*	1				1.56%	14.63%	0.00%	0.00%
WQ0244	**Total**			64	41	152	128	100.00%	100.00%	100.00%	100.00%
WQ0245	**Turtle River, PTH 5 at Ste. Rose du Lac, total of 5 samples per site per year*.**										
WQ0245	Arachnoidae	Hydracarina	Hydracarina unidentified	1							
WQ0245	Arachnoidae	Hydracarina	*Sperchon sp.*	1				0.78%	0.00%	0.00%	0.00%
WQ0245	Crustacea	Amphipoda	*Hyalella azteca*	1		1	17	0.39%	0.00%	0.15%	3.10%
WQ0245	Crustacea	Decapoda	Cambaridae unidentified	1	1						
WQ0245	Crustacea	Decapoda	*Orconectes virilis*		3						
WQ0245	Crustacea	Decapoda	*Orconectes sp.*			2	1	0.39%	0.64%	0.31%	0.18%
WQ0245	Insecta	Coleoptera	*Dubiraphia sp.*	4	6	11	3				
WQ0245	Insecta	Coleoptera	*Liodessus affinis*				7				
WQ0245	Insecta	Coleoptera	*Optioservus sp.*		1			1.56%	1.12%	1.70%	1.82%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon 1995	1996	1997	1998	% Order or Subclass 1995	1996	1997	1998
WQ0245	**Turtle River, PTH 5 at Ste. Rose du Lac, total of 5 samples per site per year[a] (continued).**										
WQ0245	Insecta	Diptera Chironomidae	Chironomidae unidentified		2	1					
WQ0245	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*	4	2						
WQ0245	Insecta	Diptera Chironomidae	*Chironomus sp.*			17	2				
WQ0245	Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*			3					
WQ0245	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*				1				
WQ0245	Insecta	Diptera Chironomidae	*Cryptotendipes sp.*			10					
WQ0245	Insecta	Diptera Chironomidae	*Demicryptochironomus sp.*	3			1				
WQ0245	Insecta	Diptera Chironomidae	*Dicrotendipes sp.*				1				
WQ0245	Insecta	Diptera Chironomidae	*Microtendipes sp.*	6	2	6	1				
WQ0245	Insecta	Diptera Chironomidae	*Paratanytarsus sp.*		5		2				
WQ0245	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*	1		13	1				
WQ0245	Insecta	Diptera Chironomidae	*Polypedilum sp.*				1				
WQ0245	Insecta	Diptera Chironomidae	*Procladius sp.*	1	1	2	3				
WQ0245	Insecta	Diptera Chironomidae	*Rheotanytarsus sp.*	1							
WQ0245	Insecta	Diptera Chironomidae	*Stenochironomus sp.*			3					
WQ0245	Insecta	Diptera Chironomidae	*Stictochironomus sp.*	2							
WQ0245	Insecta	Diptera Chironomidae	*Tanytarsus sp.*			5		7.00%	1.92%	9.26%	2.37%
WQ0245	Insecta	Diptera Miscelaneous	Diptera Misc. unidentified	3							
WQ0245	Insecta	Diptera Miscelaneous	Chaoborinae unidentified	1							
WQ0245	Insecta	Diptera Miscelaneous	*Hemerodromia sp.*		1						
WQ0245	Insecta	Diptera Miscelaneous	*Palpomyia sp.*	3	2	6	5				
WQ0245	Insecta	Diptera Miscelaneous	*Pilaria sp.*				1				
WQ0245	Insecta	Diptera Miscelaneous	*Simulium sp.*				2	2.72%	0.48%	0.93%	1.46%
WQ0245	Insecta	Ephemeroptera	Baetidae unidentified				1				
WQ0245	Insecta	Ephemeroptera	*Baetis sp.*			2					
WQ0245	Insecta	Ephemeroptera	*Caenis sp.*	25	5	19	5				
WQ0245	Insecta	Ephemeroptera	*Callibaetis sp.*		2		9				
WQ0245	Insecta	Ephemeroptera	*Centroptilum sp.*		2						
WQ0245	Insecta	Ephemeroptera	*Ephemera simulans*		2						
WQ0245	Insecta	Ephemeroptera	*Hexagenia limbata*		3						
WQ0245	Insecta	Ephemeroptera	*Hexagenia recurvata*	1							
WQ0245	Insecta	Ephemeroptera	*Hexagenia sp.*		1	8					
WQ0245	Insecta	Ephemeroptera	*Leptophlebia sp.*				4				
WQ0245	Insecta	Ephemeroptera	*Paraleptophlebia sp.*				5				
WQ0245	Insecta	Ephemeroptera	*Stenacron sp.*	17	3	15	11	16.73%	2.88%	6.79%	6.38%
WQ0245	Insecta	Hemiptera	Corixidae unidentified	4	28	22	143				
WQ0245	Insecta	Hemiptera	*Hesperocorixa sp.*	1							
WQ0245	Insecta	Hemiptera	*Mesovelia sp.*			1					
WQ0245	Insecta	Hemiptera	*Sigara lineata*	25	36	44	279				
WQ0245	Insecta	Hemiptera	*Sigara sp.*		1		5	11.67%	10.38%	10.34%	77.78%
WQ0245	Insecta	Megaloptera	*Sialis sp.*	9	10			3.50%	1.60%	0.00%	0.00%
WQ0245	Insecta	Trichoptera	*Hydatophylax sp.*				3				
WQ0245	Insecta	Trichoptera	*Nectopsyche sp.*	2							
WQ0245	Insecta	Trichoptera	*Nyctiophylax sp.*		1						
WQ0245	Insecta	Trichoptera	*Oecetis sp.*	2	1			1.56%	0.32%	0.00%	0.55%
WQ0245	Annelida	Oligochaeta	Plesiopora unidentified		11						
WQ0245	Annelida	Oligochaeta	*Limnodrilus sp.*			24	3				
WQ0245	Annelida	Oligochaeta	*Nais sp.*				1				
WQ0245	Annelida	Oligochaeta	*Tubifex sp.*			4	5	0.00%	1.76%	4.32%	1.64%
WQ0245	Gastropoda	Ctenobranchiata	*Amincola limosa*	1		3					
WQ0245	Gastropoda	Ctenobranchiata	*Amincola sp.*			1					
WQ0245	Gastropoda	Ctenobranchiata	*Cincinnatia cincinnatiensis*			1					
WQ0245	Gastropoda	Ctenobranchiata	*Marstonia decepta*	1							
WQ0245	Gastropoda	Pulmonata	*Ferrissia rivularis*	4							
WQ0245	Gastropoda	Pulmonata	*Ferrissia sp.*			7	3				
WQ0245	Gastropoda	Pulmonata	*Gyraulus sp.*				1				
WQ0245	Gastropoda	Pulmonata	*Physa sp.*	1			10	2.72%	0.00%	1.85%	2.55%
WQ0245	Pelecypoda	Sphaeriidae	*Pisidium sp.*			4	1				
WQ0245	Pelecypoda	Sphaeriidae	*Sphaerium simile*				2				
WQ0245	Pelecypoda	Sphaeriidae	*Sphaerium sp.*	131	491	413	9				
WQ0245	Pelecypoda	Unionidae	*Anodonta grandis*		1						
WQ0245	Pelecypoda	Unionidae	*Lasmigona complanata*		2			50.97%	78.91%	64.35%	2.19%
WQ0245	**Total**			257	626	648	549	100.00%	100.00%	100.00%	100.00%
WQ0250	**Valley River, PTH 20, total of 5 samples per site per year[a].**										
WQ0250	Arachnoidae	Hydracanna	Piona sp.			1		0.00%	0.00%	1.00%	0.00%
WQ0250	Crustacea	Amphipoda	*Hyalella azteca*	4				0.75%	0.00%	0.00%	0.00%
WQ0250	Crustacea	Decapoda	*Orconectes sp.*		2			0.00%	3.08%	0.00%	0.00%
WQ0250	Insecta	Coleoptera	*Dubiraphia sp.*	36							
WQ0250	Insecta	Coleoptera	*Optioservus sp.*	41		2	3				
WQ0250	Insecta	Coleoptera	*Stenelmis sp.*	24		2	1	19.06%	0.00%	4.00%	5.48%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon 1995	1996	1997	1998	% Order or Subclass 1995	1996	1997	1998
WQ0250	**Valley River, PTH 20, total of 5 samples per site per year* (continued).**										
WQ0250	Insecta	Diptera Chironomidae	Chironomidae unidentified			4	2				
WQ0250	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*	1	3		2				
WQ0250	Insecta	Diptera Chironomidae	*Chironomus sp.*	3	3						
WQ0250	Insecta	Diptera Chironomidae	*Cricotopus sp.*	16		1					
WQ0250	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*	1							
WQ0250	Insecta	Diptera Chironomidae	*Dicrotendipes sp.*		1						
WQ0250	Insecta	Diptera Chironomidae	*Microtendipes sp.*	2			2				
WQ0250	Insecta	Diptera Chironomidae	*Paralauterborniella sp.*		1						
WQ0250	Insecta	Diptera Chironomidae	*Parametriocnemus sp.*			1					
WQ0250	Insecta	Diptera Chironomidae	*Paratendipes sp.*	1							
WQ0250	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*	48	2						
WQ0250	Insecta	Diptera Chironomidae	*Procladius sp.*	12							
WQ0250	Insecta	Diptera Chironomidae	*Stenochironomus sp.*			2					
WQ0250	Insecta	Diptera Chironomidae	*Stictochironomus sp.*	2	4						
WQ0250	Insecta	Diptera Chironomidae	*Tanytarsus sp.*	3		9	1	16.79%	21.54%	17.00%	9.59%
WQ0250	Insecta	Diptera Miscelaneous	*Atherix sp.*	13	1	3					
WQ0250	Insecta	Diptera Miscelaneous	*Eriocera sp.*	2							
WQ0250	Insecta	Diptera Miscelaneous	*Hemerodromia sp.*	5							
WQ0250	Insecta	Diptera Miscelaneous	*Palpomyia sp.*	1				3.96%	1.54%	3.00%	0.00%
WQ0250	Insecta	Ephemeroptera	Ephemeroptera unidentified		1						
WQ0250	Insecta	Ephemeroptera	Baetidae unidentified				1				
WQ0250	Insecta	Ephemeroptera	*Baetis sp.*	14	11	10					
WQ0250	Insecta	Ephemeroptera	*Baetisca sp.*	2							
WQ0250	Insecta	Ephemeroptera	*Caenis sp.*	10		18	7				
WQ0250	Insecta	Ephemeroptera	*Callibaetis sp.*			3					
WQ0250	Insecta	Ephemeroptera	*Cinygmula sp.*	2	2						
WQ0250	Insecta	Ephemeroptera	*Ephemera sp.*			13	2				
WQ0250	Insecta	Ephemeroptera	*Hexagenia limbata*	1	2	1	31				
WQ0250	Insecta	Ephemeroptera	*Leptophlebia sp.*	98							
WQ0250	Insecta	Ephemeroptera	*Leucrocuta sp.*			1	19				
WQ0250	Insecta	Ephemeroptera	*Paraleptophlebia sp.*			1					
WQ0250	Insecta	Ephemeroptera	*Pseudocloeon sp.*			11					
WQ0250	Insecta	Ephemeroptera	*Stenacron sp.*	2		1					
WQ0250	Insecta	Ephemeroptera	*Stenonema sp.*	4				25.09%	24.62%	59.00%	82.19%
WQ0250	Insecta	Hemiptera	*Hesperocorixa sp.*	102							
WQ0250	Insecta	Hemiptera	*Sigara sp.*	30				24.91%	0.00%	0.00%	0.00%
WQ0250	Insecta	Megaloptera	Sialis sp.			2		0.00%	0.00%	2.00%	0.00%
WQ0250	Insecta	Odonata	*Dromogomphus sp.*	2		1		0.38%	0.00%	1.00%	0.00%
WQ0250	Insecta	Plecoptera	*Acroneuria sp.*				1				
WQ0250	Insecta	Plecoptera	*Eccoptura sp.*	3				0.57%	0.00%	0.00%	1.37%
WQ0250	Insecta	Trichoptera	*Cheumatopsyche sp.*	30	1	2					
WQ0250	Insecta	Trichoptera	*Helicopsyche sp.*			2					
WQ0250	Insecta	Trichoptera	*Hydropsyche sp.*	13	1	1		8.11%	3.08%	5.00%	0.00%
WQ0250	Annelida	Hirudinea	*Mollibdella grandis*		1						
WQ0250	Annelida	Hirudinea	*Placobdella montifera*				1				
WQ0250	Annelida	Hirudinea	*Placobdella papillifera*			1		0.00%	1.54%	1.00%	1.37%
WQ0250	Annelida	Oligochaeta	Naididae unidentified			1					
WQ0250	Annelida	Oligochaeta	*Naidium sp.*		5			0.00%	7.69%	1.00%	0.00%
WQ0250	Gastropoda	Ctenobranchiata	*Amnicola limosa*		1						
WQ0250	Gastropoda	Ctenobranchiata	*Marstonia decepta*		1						
WQ0250	Gastropoda	Pulmonata	*Fernissia sp.*			1		0.00%	3.08%	1.00%	0.00%
WQ0250	Pelecypoda	Sphaeriidae	*Pisidium sp.*		1	1					
WQ0250	Pelecypoda	Sphaeriidae	*Sphaerium sp.*	2	21	4		0.38%	33.85%	5.00%	0.00%
WQ0250	**Total**			**530**	**65**	**100**	**73**	100.00%	100.00%	100.00%	100.00%
WQ0252	**Vermilion River, PTH 20, total of 5 samples per site per year*.**										
WQ0252	Arachnoidae	Hydracarina	*Sperchon sp.*			1		0.00%	0.00%	0.44%	0.00%
WQ0252	Crustacea	Amphipoda	*Hyalella azteca*	3				1.60%	0.00%	0.00%	0.00%
WQ0252	Insecta	Coleoptera	*Dubiraphia sp.*				1				
WQ0252	Insecta	Coleoptera	*Liodessus affinis*	1			1				
WQ0252	Insecta	Coleoptera	*Optioservus sp.*	2			1				
WQ0252	Insecta	Coleoptera	*Sphaenus sp.*			1		1.60%	0.00%	0.44%	2.38%
WQ0252	Insecta	Diptera Chironomidae	Chironomidae unidentified			1	1				
WQ0252	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*	2							
WQ0252	Insecta	Diptera Chironomidae	*Chironomus sp.*				1				
WQ0252	Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*		2		3				
WQ0252	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*		2						
WQ0252	Insecta	Diptera Chironomidae	*Cryptotendipes sp.*			2					
WQ0252	Insecta	Diptera Chironomidae	*Dicrotendipes sp.*	1		2					
WQ0252	Insecta	Diptera Chironomidae	*Epoicocladius sp.*			1					
WQ0252	Insecta	Diptera Chironomidae	*Microtendipes sp.*				1				
WQ0252	Insecta	Diptera Chironomidae	*Procladius sp.*	1		1					
WQ0252	Insecta	Diptera Chironomidae	*Stenochironomus sp.*			4					
WQ0252	Insecta	Diptera Chironomidae	*Stictochironomus sp.*		54						
WQ0252	Insecta	Diptera Chironomidae	*Tanytarsus sp.*		2			2.13%	26.79%	4.80%	4.76%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon				% Order or Subclass			
				1995	1996	1997	1998	1995	1996	1997	1998
WQ0252	**Vermilion River, PTH 20, total of 5 samples per site per year[a] (continued).**										
WQ0252	Insecta	Diptera Miscelaneous	Diptera Misc. unidentified		1						
WQ0252	Insecta	Diptera Miscelaneous	*Atherix sp.*	15							
WQ0252	Insecta	Diptera Miscelaneous	*Chrysops sp.*				1				
WQ0252	Insecta	Diptera Miscelaneous	*Enocera sp.*	3	1						
WQ0252	Insecta	Diptera Miscelaneous	*Hexatoma sp.*				8				
WQ0252	Insecta	Diptera Miscelaneous	*Palpomyia sp.*		2		1				
WQ0252	Insecta	Diptera Miscelaneous	*Simulium sp.*				1				
WQ0252	Insecta	Diptera Miscelaneous	*Tipula sp.*	3				11.17%	1.79%	0.00%	8.73%
WQ0252	Insecta	Ephemeroptera	*Baetis sp.*	2	1		4				
WQ0252	Insecta	Ephemeroptera	*Baetisca lacustris*			1					
WQ0252	Insecta	Ephemeroptera	*Baetisca sp.*	6	1		1				
WQ0252	Insecta	Ephemeroptera	*Caenis sp.*	37	3	114	7				
WQ0252	Insecta	Ephemeroptera	*Callibaetis sp.*			3	1				
WQ0252	Insecta	Ephemeroptera	*Centroptilum sp.*			17					
WQ0252	Insecta	Ephemeroptera	*Ephemera simulans*	4	3						
WQ0252	Insecta	Ephemeroptera	*Ephemera sp.*		8	8					
WQ0252	Insecta	Ephemeroptera	*Hexagenia limbata*		2						
WQ0252	Insecta	Ephemeroptera	*Leptophlebia sp.*	65			1				
WQ0252	Insecta	Ephemeroptera	*Paraleptophlebia sp.*				1				
WQ0252	Insecta	Ephemeroptera	*Pseudocloeon sp.*				2				
WQ0252	Insecta	Ephemeroptera	*Stenacron sp.*			2	12				
WQ0252	Insecta	Ephemeroptera	*Stenonema sp.*	37		2		80.32%	8.04%	64.19%	23.02%
WQ0252	Insecta	Hemiptera	Corixidae unidentified	1	10	11	1				
WQ0252	Insecta	Hemiptera	*Palmacorixa gillettei*	2							
WQ0252	Insecta	Hemiptera	*Palmacorixa sp.*			9		1.60%	4.46%	8.73%	0.79%
WQ0252	Insecta	Trichoptera	*Helicopsyche sp.*		1						
WQ0252	Insecta	Trichoptera	*Hydatophylax sp.*	2							
WQ0252	Insecta	Trichoptera	*Hydroptila sp.*				1				
WQ0252	Insecta	Trichoptera	*Nectopsyche sp.*			1					
WQ0252	Insecta	Trichoptera	*Oecetis sp.*			1		1.06%	0.45%	0.87%	0.79%
WQ0252	Annelida	Oligochaeta	*Nais sp.*			1	1				
WQ0252	Annelida	Oligochaeta	*Paranais sp.*		1			0.00%	0.45%	0.44%	0.79%
WQ0252	Gastropoda	Ctenobranchiata	*Amnicola limosa*		6	23					
WQ0252	Gastropoda	Ctenobranchiata	*Marstonia decepta*		1						
WQ0252	Gastropoda	Ctenobranchiata	*Valvata sincera*		4						
WQ0252	Gastropoda	Pulmonata	*Fernissia sp.*				2				
WQ0252	Gastropoda	Pulmonata	*Gyraulus sp.*		1						
WQ0252	Gastropoda	Pulmonata	*Helisoma sp.*			1					
WQ0252	Gastropoda	Pulmonata	*Lymnaea sp.*		1						
WQ0252	Gastropoda	Pulmonata	*Physa sp.*		1	2	1	0.00%	6.25%	12.23%	2.38%
WQ0252	Pelecypoda	Sphaeriidae	*Pisidium sp.*		3	2	1				
WQ0252	Pelecypoda	Sphaeriidae	*Sphaerium simile*				46				
WQ0252	Pelecypoda	Sphaeriidae	*Sphaerium sp.*	1	109	16	24				
WQ0252	Pelecypoda	Unionidae	Unionidae unidentified		4			0.53%	51.79%	7.86%	56.35%
WQ0252	**Total**			**188**	**224**	**229**	**126**	100.00%	100.00%	100.00%	100.00%
WQ0253	**Edwards Creek, PTH 5/10, total of 5 samples per site per year[a].**										
WQ0253	Arachnoidae	Hydracarina	Hydracarina unidentified		1						
WQ0253	Arachnoidae	Hydracarina	*Lebertia sp.*	2	4	2					
WQ0253	Arachnoidae	Hydracarina	*Sperchon sp.*			1		0.21%	0.57%	0.77%	0.00%
WQ0253	Crustacea	Amphipoda	*Hyalella azteca*			1		0.00%	0.00%	0.26%	0.00%
WQ0253	Crustacea	Decapoda	*Orconectes virilis*		1	1					
WQ0253	Crustacea	Decapoda	*Orconectes sp.*			2		0.00%	0.11%	0.77%	0.00%
WQ0253	Insecta	Coleoptera	*Donacia sp.*			1					
WQ0253	Insecta	Coleoptera	*Dubiraphia sp.*	3	3						
WQ0253	Insecta	Coleoptera	*Liodessus sp.*	1							
WQ0253	Insecta	Coleoptera	*Optioservus sp.*	14		14					
WQ0253	Insecta	Coleoptera	*Pyrrhalta sp.*			1					
WQ0253	Insecta	Coleoptera	*Stenelmis sp.*			5		1.88%	0.34%	5.37%	0.00%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon				% Order or Subclass			
				1995	1996	1997	1998	1995	1996	1997	1998
WQ0253	**Edwards Creek, PTH 5/10, total of 5 samples per site per year* (continued).**										
WQ0253	Insecta	Diptera Chironomidae	Chironomidae unidentified	2		3					
WQ0253	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*	4	7	3					
WQ0253	Insecta	Diptera Chironomidae	*Chironomus sp.*		25						
WQ0253	Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*		2	3					
WQ0253	Insecta	Diptera Chironomidae	*Cricotopus sp.*	43		3					
WQ0253	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*		3						
WQ0253	Insecta	Diptera Chironomidae	*Cryptotendipes sp.*		3						
WQ0253	Insecta	Diptera Chironomidae	*Endochironomus sp.*	1							
WQ0253	Insecta	Diptera Chironomidae	*Epoicocladius sp.*				1				
WQ0253	Insecta	Diptera Chironomidae	*Glyptotendipes sp.*		2						
WQ0253	Insecta	Diptera Chironomidae	*Microtendipes sp.*	21	1						
WQ0253	Insecta	Diptera Chironomidae	*Paramerina sp.*		2						
WQ0253	Insecta	Diptera Chironomidae	*Paratanytarsus sp.*	94	2						
WQ0253	Insecta	Diptera Chironomidae	*Paratendipes sp.*	2	137						
WQ0253	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*		360	1					
WQ0253	Insecta	Diptera Chironomidae	*Polypedilum sp.*	4	1	3	1				
WQ0253	Insecta	Diptera Chironomidae	*Procladius sp.*	2	3						
WQ0253	Insecta	Diptera Chironomidae	*Rheotanytarsus sp.*	143							
WQ0253	Insecta	Diptera Chironomidae	*Stenochironomus sp.*			2					
WQ0253	Insecta	Diptera Chironomidae	*Stictochironomus sp.*	4	3						
WQ0253	Insecta	Diptera Chironomidae	Tanypodinae unidentified	3							
WQ0253	Insecta	Diptera Chironomidae	*Tanytarsus sp.*		11	13		33.82%	64.52%	7.93%	3.03%
WQ0253	Insecta	Diptera Miscelaneous	Diptera Misc. unidentified	17	34						
WQ0253	Insecta	Diptera Miscelaneous	*Atherix sp.*	1	2	11					
WQ0253	Insecta	Diptera Miscelaneous	*Eriocera sp.*	20	1						
WQ0253	Insecta	Diptera Miscelaneous	*Hemerodromia sp.*	6							
WQ0253	Insecta	Diptera Miscelaneous	*Hexatoma sp.*		2	5	13				
WQ0253	Insecta	Diptera Miscelaneous	*Limnophila sp.*	2							
WQ0253	Insecta	Diptera Miscelaneous	*Limnophora sp.*	2							
WQ0253	Insecta	Diptera Miscelaneous	*Palpomyia sp.*	3	2	1					
WQ0253	Insecta	Diptera Miscelaneous	*Tabanus sp.*	4							
WQ0253	Insecta	Diptera Miscelaneous	*Tipula sp.*	4	1			6.18%	4.82%	4.35%	19.70%
WQ0253	Insecta	Ephemeroptera	Baetidae unidentified		10						
WQ0253	Insecta	Ephemeroptera	*Baetis sp.*	21	11	12					
WQ0253	Insecta	Ephemeroptera	*Baetisca sp.*	18	15	21	6				
WQ0253	Insecta	Ephemeroptera	*Caenis sp.*	191	128	150	26				
WQ0253	Insecta	Ephemeroptera	*Ephemera simulans*	3	8						
WQ0253	Insecta	Ephemeroptera	*Ephemera sp*	3	29	27	7				
WQ0253	Insecta	Ephemeroptera	*Heptagenia sp.*		2						
WQ0253	Insecta	Ephemeroptera	*Hexagenia limbata*		1						
WQ0253	Insecta	Ephemeroptera	*Leptophlebia sp.*	38		1	4				
WQ0253	Insecta	Ephemeroptera	*Leucrocuta sp.*		2						
WQ0253	Insecta	Ephemeroptera	*Paraleptophlebia sp.*		13	13	1				
WQ0253	Insecta	Ephemeroptera	*Pseudocloeon sp.*		5	3					
WQ0253	Insecta	Ephemeroptera	*Stenacron sp.*		1						
WQ0253	Insecta	Ephemeroptera	*Stenonema sp.*	20	6	11	1				
WQ0253	Insecta	Ephemeroptera	*Tricorythodes sp.*	4		1		31.20%	26.52%	61.13%	68.18%
WQ0253	Insecta	Megaloptera	Sialis sp.			1		0.00%	0.00%	0.26%	0.00%
WQ0253	Insecta	Hemiptera	Hemiptera unidentified		1						
WQ0253	Insecta	Hemiptera	*Sigara sp.*	7				0.73%	0.11%	0.00%	0.00%
WQ0253	Insecta	Odonata	*Dromogomphus sp.*	40	7						
WQ0253	Insecta	Odonata	*Ophiogomphus sp*		1	1	2	4.19%	0.92%	0.26%	3.03%
WQ0253	Insecta	Plecoptera	*Acroneuria sp.*			1					
WQ0253	Insecta	Plecoptera	*Eccoptura sp.*	1							
WQ0253	Insecta	Plecoptera	*Pteronarcys sp.*			1		0.10%	0.00%	0.51%	0.00%
WQ0253	Insecta	Trichoptera	*Cheumatopsyche sp.*	110		25	2				
WQ0253	Insecta	Trichoptera	*Hydatophylax sp.*	1							
WQ0253	Insecta	Trichoptera	*Hydropsyche sp.*	91	1	31	1				
WQ0253	Insecta	Trichoptera	*Hydroptila sp.*	1							
WQ0253	Insecta	Trichoptera	Hydroptilidae unidentified		2						
WQ0253	Insecta	Trichoptera	*Ochrotrichia sp.*		1						
WQ0253	Insecta	Trichoptera	*Ptilostomis sp.*	1				21.36%	0.46%	14.32%	4.55%
WQ0253	Annelida	Branchiobdellida	*Cambarincola sp.*			2		0.00%	0.00%	0.51%	0.00%
WQ0253	Annelida	Oligochaeta	Prosopora unidentified		4						
WQ0253	Annelida	Oligochaeta	*Aeolosoma sp.*		7	1					
WQ0253	Annelida	Oligochaeta	*Nais sp.*			9		0.00%	1.26%	2.56%	0.00%
WQ0253	Gastropoda	Ctenobranchiata	*Valvata sp.*		1						
WQ0253	Gastropoda	Pulmonata	*Ferrissia sp.*			2					
WQ0253	Gastropoda	Pulmonata	*Physa sp.*	3	1	2	1	0.31%	0.23%	1.02%	1.52%
WQ0253	Pelecypoda	Sphaeriidae	*Pisidium sp.*		1			0.00%	0.11%	0.00%	0.00%
WQ0253	**Total**			955	871	391	66	100.00%	100.00%	100.00%	100.00%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon 1995	1996	1997	1998	% Order or Subclass 1995	1996	1997	1998
WQ0255	**Wilson River, PTH 20, total of 5 samples per site per year*.**										
WQ0255	Crustacea	Decapoda	Cambaridae unidentified	1							
WQ0255	Crustacea	Decapoda	*Orconectes immunis*		2						
WQ0255	Crustacea	Decapoda	*Orconectes virilis*		1						
WQ0255	Crustacea	Decapoda	*Orconectes sp.*			2		0.33%	2.38%	0.59%	0.00%
WQ0255	Insecta	Coleoptera	*Dubiraphia sp.*	5	7			1.67%	5.56%	0.00%	0.00%
WQ0255	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*		2						
WQ0255	Insecta	Diptera Chironomidae	*Chironomus sp.*	1	12	7	1				
WQ0255	Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*		1	1					
WQ0255	Insecta	Diptera Chironomidae	*Cryptochironomus sp.*	1		2					
WQ0255	Insecta	Diptera Chironomidae	*Endochironomus sp.*	1							
WQ0255	Insecta	Diptera Chironomidae	*Glyptotendipes sp.*		2						
WQ0255	Insecta	Diptera Chironomidae	*Microtendipes sp.*		1						
WQ0255	Insecta	Diptera Chironomidae	*Omisus sp.*	1							
WQ0255	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*		2						
WQ0255	Insecta	Diptera Chironomidae	*Polypedilum sp.*		1	5					
WQ0255	Insecta	Diptera Chironomidae	*Procladius sp.*		2						
WQ0255	Insecta	Diptera Chironomidae	*Stenochironomus sp.*			46					
WQ0255	Insecta	Diptera Chironomidae	*Stictochironomus sp.*	1	3						
WQ0255	Insecta	Diptera Chironomidae	*Tanytarsus sp.*		5			1.67%	24.60%	17.89%	0.87%
WQ0255	Insecta	Diptera Miscelaneous	Diptera Misc. unidentified		1						
WQ0255	Insecta	Diptera Miscelaneous	*Palpomyia sp.*		1		1				
WQ0255	Insecta	Diptera Miscelaneous	*Tipula sp.*	1				0.33%	1.59%	0.00%	0.87%
WQ0255	Insecta	Ephemeroptera	*Baetis sp.*		3		2				
WQ0255	Insecta	Ephemeroptera	*Caenis sp.*	32	49	9	17				
WQ0255	Insecta	Ephemeroptera	*Callibaetis sp.*			1	3				
WQ0255	Insecta	Ephemeroptera	*Centroptilum sp.*			6	2				
WQ0255	Insecta	Ephemeroptera	*Ephemera simulans*		4						
WQ0255	Insecta	Ephemeroptera	*Ephemera sp.*		4	1	1				
WQ0255	Insecta	Ephemeroptera	*Hexagenia limbata*			2					
WQ0255	Insecta	Ephemeroptera	*Hexagenia sp.*				2				
WQ0255	Insecta	Ephemeroptera	*Leptophlebia sp.*	130			2				
WQ0255	Insecta	Ephemeroptera	*Paraleptophlebia sp.*				2				
WQ0255	Insecta	Ephemeroptera	*Stenacron sp.*	20	14	11	59				
WQ0255	Insecta	Ephemeroptera	*Stenonema sp.*				1	60.87%	58.73%	8.80%	79.13%
WQ0255	Insecta	Hemiptera	Corixidae unidentified	95		186	16				
WQ0255	Insecta	Hemiptera	*Palmacorixa sp.*			6	1				
WQ0255	Insecta	Hemiptera	*Sigara sp.*	5		1		33.44%	0.00%	56.60%	14.78%
WQ0255	Insecta	Megaloptera	*Sialis sp.*		1	1	1	0.00%	0.79%	0.29%	0.87%
WQ0255	Insecta	Odonata	*Aeschna sp.*	1				0.33%	0.00%	0.00%	0.00%
WQ0255	Insecta	Trichoptera	*Cheumatopsyche sp.*	1							
WQ0255	Insecta	Trichoptera	*Helicopsyche sp.*		1						
WQ0255	Insecta	Trichoptera	*Oecetis sp.*	1							
WQ0255	Insecta	Trichoptera	*Ptilostomis sp.*		1			0.67%	1.59%	0.00%	0.00%
WQ0255	Annelida	Hirudinea	*Dina sp.*		1			0.00%	0.79%	0.00%	0.00%
WQ0255	Gastropoda	Ctenobranchiata	*Amnicola limosa*			30	2				
WQ0255	Gastropoda	Ctenobranchiata	*Marstonia decepta*			7					
WQ0255	Gastropoda	Ctenobranchiata	*Probythinella lacustris*		1						
WQ0255	Gastropoda	Pulmonata	*Fernissia sp.*				1				
WQ0255	Gastropoda	Pulmonata	*Physa sp.*	1				0.33%	0.79%	10.85%	2.61%
WQ0255	Pelecypoda	Sphaeriidae	*Pisidium sp.*			3	1				
WQ0255	Pelecypoda	Sphaeriidae	*Sphaerium sp.*	1	4	14		0.33%	3.17%	4.99%	0.87%
WQ0255	**Total**			**299**	**126**	**341**	**115**	100.00%	100.00%	100.00%	100.00%
WQ0259	**Woody River, PR 268 west of Lensawood, total of 5 samples per site per year*.**										
WQ0259	Crustacea	Amphipoda	*Hyalella azteca*	1				1.08%	0.00%	0.00%	0.00%
WQ0259	Insecta	Coleoptera	*Dubiraphia sp.*			1					
WQ0259	Insecta	Coleoptera	*Helophorus sp.*			1					
WQ0259	Insecta	Coleoptera	*Optioservus sp.*	2		14	1	2.15%	0.00%	1.36%	0.13%

Appendix 1. Macroinvertebrates collected per site with numbers per taxon and percentage composition, 1995 to 1998 (cont'd).

Site	Phylum or Class	Order or Subclass	Genus & species or Taxonomic Group	Number of Organisms/Taxon				% Order or Subclass			
				1995	1996	1997	1998	1995	1996	1997	1998
WQ0259	**Woody River, PR 268 west of Lensewood, total of 5 samples per site per year* (continued).**										
WQ0259	Insecta	Diptera Chironomidae	Chironomidae unidentified	1	1	5	8				
WQ0259	Insecta	Diptera Chironomidae	*Ablabesmyia sp.*			3	1				
WQ0259	Insecta	Diptera Chironomidae	*Chironomus sp.*			5	386				
WQ0259	Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*			20	1				
WQ0259	Insecta	Diptera Chironomidae	*Corynoneura sp.*			1					
WQ0259	Insecta	Diptera Chironomidae	*Cricotopus sp.*			1	1				
WQ0259	Insecta	Diptera Chironomidae	*Cryptochirnnomus sp.*				2				
WQ0259	Insecta	Diptera Chironomidae	*Dicrotendipes sp.*				1				
WQ0259	Insecta	Diptera Chironomidae	*Endochironomus sp.*				4				
WQ0259	Insecta	Diptera Chironomidae	*Epoicocladius sp.*			1					
WQ0259	Insecta	Diptera Chironomidae	*Micropsectra sp.*			2					
WQ0259	Insecta	Diptera Chironomidae	*Microtendipes sp.*			10					
WQ0259	Insecta	Diptera Chironomidae	*Phaenopsectra sp.*				10				
WQ0259	Insecta	Diptera Chironomidae	*Polypedilum sp.*		1	5	34				
WQ0259	Insecta	Diptera Chironomidae	*Procladius sp.*			1	7				
WQ0259	Insecta	Diptera Chironomidae	*Psectrocladius sp.*				18				
WQ0259	Insecta	Diptera Chironomidae	*Robackia demeijerei*			12					
WQ0259	Insecta	Diptera Chironomidae	*Robackia sp.*		10						
WQ0259	Insecta	Diptera Chironomidae	*Stenochironomus sp.*			22					
WQ0259	Insecta	Diptera Chironomidae	*Stictochironomus sp.*	8	17		8				
WQ0259	Insecta	Diptera Chironomidae	*Tanytarsus sp.*			18	2	9.68%	69.05%	10.26%	60.75%
WQ0259	Insecta	Diptera Miscelaneous	Diptera unidentified				5				
WQ0259	Insecta	Diptera Miscelaneous	*Atherix sp.*			1					
WQ0259	Insecta	Diptera Miscelaneous	*Chrysops sp.*	1							
WQ0259	Insecta	Diptera Miscelaneous	*Eriocera sp.*	10	4						
WQ0259	Insecta	Diptera Miscelaneous	*Hexatoma sp.*			17	1				
WQ0259	Insecta	Diptera Miscelaneous	*Ormosia sp.*			1					
WQ0259	Insecta	Diptera Miscelaneous	*Palpomyia sp.*	1		5	6	12.90%	9.52%	2.32%	1.51%
WQ0259	Insecta	Ephemeroptera	*Baetis sp.*	2		13	3				
WQ0259	Insecta	Ephemeroptera	*Baetisca sp.*	7		3	13				
WQ0259	Insecta	Ephemeroptera	*Caenis sp.*	1		10	14				
WQ0259	Insecta	Ephemeroptera	*Centroptilum sp.*				5				
WQ0259	Insecta	Ephemeroptera	*Ephemera sp*	5		43	6				
WQ0259	Insecta	Ephemeroptera	*Hexagenia limbata*		2		62				
WQ0259	Insecta	Ephemeroptera	*Hexagenia rigida*	2							
WQ0259	Insecta	Ephemeroptera	*Hexagenia sp.*			624					
WQ0259	Insecta	Ephemeroptera	*Leptophlebia sp.*	1			58				
WQ0259	Insecta	Ephemeroptera	*Leucrocuta sp.*			4					
WQ0259	Insecta	Ephemeroptera	*Paraleptophlebia sp.*			1	32				
WQ0259	Insecta	Ephemeroptera	*Pseudocloeon sp.*			6					
WQ0259	Insecta	Ephemeroptera	*Siphloplecton sp.*				2				
WQ0259	Insecta	Ephemeroptera	*Stenacron sp.*				1				
WQ0259	Insecta	Ephemeroptera	*Stenonema sp.*			11	5	19.35%	4.76%	69.22%	25.28%
WQ0259	Insecta	Hemiptera	Corixidae unidentified	1		16	12				
WQ0259	Insecta	Hemiptera	*Hesperocorixa sp.*	3							
WQ0259	Insecta	Hemiptera	*Sigara lineata*	2							
WQ0259	Insecta	Hemiptera	*Sigara sp.*	19		1					
WQ0259	Insecta	Hemiptera	*Sigara trilineata*	4				31.18%	0.00%	1.65%	1.51%
WQ0259	Insecta	Odonata	*Dromogomphus sp.*	1		8	2				
WQ0259	Insecta	Odonata	*Gomphus sp.*				1				
WQ0259	Insecta	Odonata	*Ophiogomphus sp.*		1	1	1				
WQ0259	Insecta	Odonata	*Stylurus sp.*				1	1.08%	2.38%	0.87%	0.63%
WQ0259	Insecta	Plecoptera	Plecoptera unidentified			7					
WQ0259	Insecta	Plecoptera	*Isoperla sp.*				31	0.00%	0.00%	0.68%	3.90%
WQ0259	Insecta	Trichoptera	*Brachycentrus sp.*	1		5	7				
WQ0259	Insecta	Trichoptera	*Cheumatopsyche sp.*			5					
WQ0259	Insecta	Trichoptera	*Hydatophylax sp.*	1			2				
WQ0259	Insecta	Trichoptera	*Hydropsyche sp.*	1		1	3				
WQ0259	Insecta	Trichoptera	*Nectopsyche sp.*			54	15				
WQ0259	Insecta	Trichoptera	*Pycnopsyche sp.*				1				
WQ0259	Insecta	Trichoptera	*Oecetis sp.*			5		3.23%	0.00%	6.78%	3.52%
WQ0259	Annelida	Hirudinea	*Actinobdella sp.*			2					
WQ0259	Annelida	Hirudinea	*Batracobdella picta*	1				1.08%	0.00%	0.19%	0.00%
WQ0259	Gastropoda	Ctenobranchiata	*Amincola limosa*		1						
WQ0259	Gastropoda	Pulmonata	*Ferrissia sp.*				1				
WQ0259	Gastropoda	Pulmonata	*Lymnaea sp.*			1					
WQ0259	Gastropoda	Pulmonata	*Physa sp.*				17	0.00%	2.38%	0.10%	2.26%
WQ0259	Pelecypoda	Sphaeriidae	*Pisidium sp.*	1	1	3					
WQ0259	Pelecypoda	Sphaeriidae	*Sphaerium sp.*	15	4	62	3				
WQ0259	Pelecypoda	Unionidae	Unionidae unidentified			1	1				
WQ0259	Pelecypoda	Unionidae	*Strophitus undulatus*	1				18.28%	11.90%	6.39%	0.50%
WQ0259	**Total**			**93**	**42**	**1033**	**795**	100.00%	100.00%	99.81%	100.00%

Appendix 2. The Community Loss Index (Courtemanch and Davies 1987) compares taxa within a sample or composite pooled sample to taxa in a reference sample. This table shows the mean reference sample from the entire database.

Phylum or Class	Order or Suborder	Genus and species or Group	Total Number	Site Average[1]	Sample Average[1]	Reference Number of Taxa
Crustacea	Amphipoda	*Hyalella azteca*	28274	262	52	
Insecta	Ephemeroptera	*Caenis sp.*	5180	48	10	
Crustacea	Amphipoda	*Gammarus sp.*	4943	46	9	
Insecta	Hemiptera	Corixidae unidentified	3140	29	6	
Gastropoda	Ctenobranchiata	*Amnicola limosa*	2325	22	4	
Pelecypoda	Sphaeridae	*Sphaerium sp.*	1633	15	3	
Insecta	Diptera Chironomidae	*Chironomus sp.*	1538	14	3	
Insecta	Ephemeroptera	*Stenacron sp.*	1310	12	2	
Insecta	Ephemeroptera	*Baetis sp.*	1119	10	2	
Insecta	Ephemeroptera	*Leptophlebia sp.*	811	8	2	
Insecta	Hemiptera	*Sigara sp.*	752	7	1	
Insecta	Ephemeroptera	*Hexagenia sp.*	749	7	1	
Insecta	Diptera Chironomidae	*Phaenopsectra sp.*	747	7	1	
Gastropoda	Pulmonata	*Physa sp.*	743	7	1	
Insecta	Diptera Chironomidae	*Procladius sp.*	633	6	1	
Insecta	Odonata	*Enallagma sp.*	609	6	1	
Insecta	Hemiptera	*Sigara lineata*	609	6	1	
Insecta	Ephemeroptera	*Stenonema sp.*	547	5	1	
Pelecypoda	Unionidae	*Anodonta grandis*	525	5	1	
Insecta	Trichoptera	*Cheumatopsyche sp.*	525	5	1	
Insecta	Diptera Chironomidae	*Dicrotendipes sp.*	511	5	1	
Insecta	Ephemeroptera	*Hexagenia limbata*	488	4	1	
Insecta	Ephemeroptera	*Paraleptophlebia sp.*	488	4	1	
Insecta	Coleoptera	*Dubiraphia sp.*	467	4	1	
Insecta	Ephemeroptera	*Callibaetis sp.*	382	4	1	
Pelecypoda	Sphaeridae	*Pisidium sp.*	344	3	1	
Insecta	Trichoptera	*Hydropsyche sp.*	342	3	1	
Insecta	Diptera Chironomidae	*Tanytarsus sp.*	326	3	1	Reference
Insecta	Hemiptera	*Hesperocorixa sp.*	294	3	1	Single Sample
Insecta	Diptera Miscellaneous	*Palpomyia sp.*	293	3	1	30
Insecta	Megaloptera	*Sialis sp.*	261	2	0	
Gastropoda	Pulmonata	*Fernsia rivularis*	236	2	0	
Insecta	Diptera Chironomidae	*Cricotopus sp.*	231	2	0	
Insecta	Diptera Chironomidae	*Polypedilum sp.*	227	2	0	
Gastropoda	Pulmonata	*Ferrissia sp.*	226	2	0	
Insecta	Diptera Chironomidae	Chironomidae unidentified	225	2	0	
Insecta	Ephemeroptera	*Baetisca sp.*	224	2	0	
Insecta	Trichoptera	*Neureclipsis sp.*	212	2	0	
Annelida	Branchiobdellida	*Cambarincola sp.*	209	2	0	
Gastropoda	Ctenobranchiata	*Cincinnatia cincinnatiensis*	209	2	0	
Insecta	Diptera Chironomidae	*Rheotanytarsus sp.*	209	2	0	
Insecta	Ephemeroptera	*Ephemera sp.*	208	2	0	
Gastropoda	Pulmonata	*Gyraulus sp.*	188	2	0	
Insecta	Diptera Chironomidae	*Paratendipes sp.*	185	2	0	
Insecta	Diptera Chironomidae	*Microtendipes sp.*	179	2	0	
Insecta	Trichoptera	*Nectopsyche sp.*	177	2	0	
Insecta	Diptera Chironomidae	*Ablabesmyia sp.*	174	2	0	
Insecta	Diptera Miscellaneous	*Simulium sp.*	174	2	0	
Insecta	Hemiptera	*Plea striola*	172	2	0	
Insecta	Ephemeroptera	*Pseudocloeon sp.*	164	2	0	
Insecta	Diptera Chironomidae	*Stictochironomus sp.*	164	2	0	
Insecta	Coleoptera	*Optioservus sp.*	141	1	0	
Insecta	Ephemeroptera	*Centroptilum sp.*	131	1	0	
Insecta	Diptera Chironomidae	*Cryptotendipes sp.*	128	1	0	
Insecta	Odonata	*Dromogomphus sp.*	125	1	0	
Pelecypoda	Sphaeridae	*Sphaerium simile*	122	1	0	
Insecta	Hemiptera	*Callicorixa sp.*	121	1	0	
Insecta	Diptera Chironomidae	*Paralanytarsus sp.*	115	1	0	
Insecta	Diptera Chironomidae	*Stenochironomus sp.*	112	1	0	
Insecta	Diptera Chironomidae	*Chironomus plumosus*	110	1	0	
Annelida	Oligochaeta	*Tubifex sp.*	110	1	0	
Annelida	Oligochaeta	*Limnodrilus sp.*	109	1	0	
Insecta	Diptera Chironomidae	*Cladotanytarsus sp.*	104	1	0	
Gastropoda	Ctenobranchiata	*Valvata tricarinata*	103	1	0	
Insecta	Diptera Miscellaneous	*Atherix sp.*	95	1	0	
Arachnoidea	Hydracarina	*Hydracarina unidentified*	88	1	0	
Insecta	Diptera Chironomidae	*Endochironomus sp.*	87	1	0	
Oligochaeta	Plesiopora	*Nais sp.*	87	1	0	
Insecta	Hemiptera	*Trichocorixa borealis*	83	1	0	
Insecta	Diptera Chironomidae	*Clinotanypus sp.*	82	1	0	
Crustacea	Decapoda	*Orconectes sp.*	80	1	0	
Insecta	Ephemeroptera	*Ephemera simulans*	78	1	0	
Insecta	Diptera Miscellaneous	Diptera Miscellaneous unidentified	75	1	0	
Insecta	Diptera Chironomidae	*Cryptochironomus sp.*	72	1	0	
Annelida	Oligochaeta	*Paranais sp.*	71	1	0	
Annelida	Oligochaeta	*Dero sp.*	66	1	0	
Annelida	Oligochaeta	*Aeolosoma sp.*	61	1	0	
Insecta	Diptera Miscellaneous	*Hexatoma sp.*	60	1	0	
Insecta	Coleoptera	*Stenelmis sp.*	60	1	0	
Insecta	Diptera Miscellaneous	*Eriocera sp.*	58	1	0	Reference
Insecta	Coleoptera	*Haliplus borealis*	58	1	0	Pooled Sample
Annelida	Hirudinea	*Dina sp.*	56	1	0	(5 samples/site)
Insecta	Trichoptera	*Polycentropus sp.*	54	1	0	83

1. Average numbers of organisms per taxa per site (pool of five samples) were calculated from the 1995 though 1998 data base. All average values of less than 1 were excluded from the data base reference. Although this report uses the pooled sample reference, a potential reference for a single sample is also shown.

Appendix 3. Average total alkalinity and sulphate used in estimating CTQp[1] for each site from 1995 through 1998 and explanation of process for derivation of CTQp.

Stream	Location	Site	Date	Average Total Alkalinity (mg/L)	Average Sulphate (mg/L)
Boyne R.	Carman	WQ0029	1995	277	147
Boyne R.	Carman	WQ0029	1996	326	154
Boyne R.	Carman	WQ0029	1997	289	122
Boyne R.	Carman	WQ0029	1998	243	72
Brokenhead R.	PTH 59	WQ0038	1995	228	15
Brokenhead R.	PTH 59	WQ0038	1996	286	14
Brokenhead R.	PTH 59	WQ0038	1997	192	26
Brokenhead R.	PTH 59	WQ0038	1998	226	11
La Salle R.	St. Norbert	WQ0068	1995	218	113
La Salle R.	St. Norbert	WQ0068	1996	327	177
La Salle R.	St. Norbert	WQ0068	1997	244	197
La Salle R.	St. Norbert	WQ0068	1998	235	99
L. Saskatchewan R.	PTH 25	WQ0105	1995	300	122
L. Saskatchewan R.	PTH 25	WQ0105	1996	313	189
L. Saskatchewan R.	PTH 25	WQ0105	1997	275	148
L. Saskatchewan R.	PTH 25	WQ0105	1998	240	179
Rat R.	PR 303	WQ0131	1995	286	18
Rat R.	PR 303	WQ0131	1996	328	14
Rat R.	PR 303	WQ0131	1997	308	40
Rat R.	PR 303	WQ0131	1998	285	18
Roseau R. Dam	W of PR200	WQ0153	1995	238	15
Roseau R. Dam	W of PR200	WQ0153	1996	258	13
Roseau R. Dam	W of PR200	WQ0153	1997	236	31
Roseau R. Dam	W of PR200	WQ0153	1998	232	12
Seine R.	PTH 100	WQ0166	1995	259	17
Seine R.	PTH 100	WQ0166	1996	223	25
Seine R.	PTH 100	WQ0166	1997	260	31
Seine R.	PTH 100	WQ0166	1998	270	11
Whitemud R.	Westbourne	WQ0197	1995	272	21
Whitemud R.	Westbourne	WQ0197	1996	313	15
Whitemud R.	Westbourne	WQ0197	1997	285	18
Whitemud R.	Westbourne	WQ0197	1998	274	52
N. Duck R.	PTH 10	WQ0217	1995	255	13
N. Duck R.	PTH 10	WQ0217	1996	258	10
N. Duck R.	PTH 10	WQ0217	1997	210	31
N. Duck R.	PTH 10	WQ0217	1998	231	11
Sclater R.	PTH 20	WQ0220	1995	213	15
Sclater R.	PTH 20	WQ0220	1996	238	10
Sclater R.	PTH 20	WQ0220	1997	215	26
Sclater R.	PTH 20	WQ0220	1998	244	19
Fishing R.	PTH 20	WQ0223	1995	234	16
Fishing R.	PTH 20	WQ0223	1996	228	12
Fishing R.	PTH 20	WQ0223	1997	225	26
Fishing R.	PTH 20	WQ0223	1998	255	36
Mossy R.	PR 364	WQ0226	1995	148	53
Mossy R.*	PR 364	WQ0226	1996	190	84
Mossy R.	PR 364	WQ0226	1997	160	67
Mossy R.	PR 364	WQ0226	1998	171	82

Appendix 3. Average total alkalinity and sulphate used in estimating CTQp[1] for each site from 1995 through 1998 and explanation of process for derivation of CTQp (continued).

Stream	Location	Site	Date	Average Total Alkalinity (mg/L)	Average Sulphate (mg/L)
Ochre R.	PTH 20	WQ0227	1995	259	42
Ochre R.	PTH 20	WQ0227	1996	241	31
Ochre R.	PTH 20	WQ0227	1997	245	53
Ochre R.	PTH 20	WQ0227	1998	248	27
Pine R.	PTH 20	WQ0233	1995	202	12
Pine R.	PTH 20	WQ0233	1996	235	12
Pine R.	PTH 20	WQ0233	1997	203	51
Pine R.	PTH 20	WQ0233	1998	223	40
Swan R.	PR 268	WQ0244	1995	192	63
Swan R.	PR 268	WQ0244	1996	209	46
Swan R.	PR 268	WQ0244	1997	191	82
Swan R.	PR 268	WQ0244	1998	219	82
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1995	242	50
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1996	233	61
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1997	245	62
Turtle R. @ Ste. Rose	PTH 5	WQ0245	1998	269	75
Valley R.	PTH 20	WQ0250	1995	190	48
Valley R.	PTH 20	WQ0250	1996	220	54
Valley R.	PTH 20	WQ0250	1997	206	72
Valley R.	PTH 20	WQ0250	1998	236	117
Vermilion R.	PTH 20	WQ0252	1995	216	115
Vermilion R.	PTH 20	WQ0252	1996	218	95
Vermilion R.	PTH 20	WQ0252	1997	212	87
Vermilion R.	PTH 20	WQ0252	1998	219	83
Edwards Cr.	PTH 5/10	WQ0253	1995	192	67
Edwards Cr.	PTH 5/10	WQ0253	1996	199	79
Edwards Cr.	PTH 5/10	WQ0253	1997	214	84
Edwards Cr.	PTH 5/10	WQ0253	1998	206	50
Wilson R.	PTH 20	WQ0255	1995	228	173
Wilson R.	PTH 20	WQ0255	1996	244	153
Wilson R.	PTH 20	WQ0255	1997	227	143
Wilson R.	PTH 20	WQ0255	1998	273	145
Woody R.	PR 268	WQ0259	1995	181	46
Woody R.	PR 268	WQ0259	1996	198	38
Woody R.	PR 268	WQ0259	1997	171	53
Woody R.	PR 268	WQ0259	1998	208	63
Souris R.	Treesbank	WQ0350	1995	369	313
Souris R.	Treesbank	WQ0350	1996	445	337
Souris R.	Treesbank	WQ0350	1997	370	246
Souris R.	Treesbank	WQ0350	1998	347	226
Marsh R.	PR 303	WQ0365	1995	175	17
Marsh R.	PR 303	WQ0365	1996	305	37
Marsh R.	PR 303	WQ0365	1997	278	39
Marsh R.	PR 303	WQ0365	1998	203	54
Cypress R.	NE of town	WQ0398	1995	298	301
Cypress R.	NE of town	WQ0398	1996	340	289
Cypress R.	NE of town	WQ0398	1997	263	264
Cypress R.	NE of town	WQ0398	1998	233	160

Appendix 3. Average total alkalinity and sulphate used in estimating CTQp[1] for each site from 1995 through 1998 and explanation of process for derivation of CTQp (continued).

Stream	Location	Site	Date	Average Total Alkalinity (mg/L)	Average Sulphate (mg/L)
Waterhen R.**	Waterhen	WQ0561	1995	150	87
Waterhen R.	Waterhen	WQ0561	1996	160	69
Waterhen R.	Waterhen	WQ0561	1997	159	71
Waterhen R.	Waterhen	WQ0561	1998	150	61
Cooks Creek	Boundary Rd.	WQ0643	1996	314	113
Cooks Creek	Boundary Rd.	WQ0643	1997	334	86
Cooks Creek	Boundary Rd.	WQ0643	1998	330	72
Cooks Creek	S of Millbrook	WQ0644	1996	266	22
Cooks Creek	S of Millbrook	WQ0644	1997	288	29
Pipestone Cr. Diversion	Boundary of the RMs of Pipesone and Sifton	WQ1242	1996	298	~180
Pipestone Cr. Diversion	Boundary	WQ1242	1997	235	170
Pipestone Cr. Diversion	Boundary	WQ1242	1998	245	189

1. CTQp is the predicted Community Tolerance Quotient based on stream gradient, substrate, total alkalinity, and sulphate. The CTQp is compared with the average of Tolerance Quotients for individuals within a taxon (CTQa) to derive the BCI or Biotic Condition Index (Winget and Mangum 1979). A modified version of the Winget and Mangum key for the predicted Community Tolerance Quotients (CTQp) for streams examined in this report is shown in the following table.

		Key No.	CTQp
1. Sream Gradient (%)	0.1-1.2	2	
2. Substrate Mostly Gravel & Rubble		3	
Sand (or finer substrate) & Boulder, Rubble or Gravel		7	
3. Total Alkalinity (mg/L)	0-199	4	
	200-300	5	
	>300	6	
4. Sulphate (mg/L)	0-149		53
	150-300		85
	>300		103
5. Sulphate (mg/L)	0-149		55
	150-300		86
	>300		103
6. Sulphate (mg/L)	0-149		89
	150-300		97
	>300		108
7. Total Alkalinity (mg/L)	0-199	12	
	200-300	13	
	>300	14	
8. Sulphate (mg/L)	0-149		60
	150-300		90
	>300		108
9. Sulphate (mg/L)	0-149		60
	150-300		90
	>300		108
10. Sulphate (mg/L)	0-149		90
	150-300		99
	>300		108

Appendix 4. Calculations used for biological scoring using data from Table 2 and metric evaluation from Figure 2.

Stream	Site	Date	Dominant Taxa (%)	Taxa Richness Site Value/Reference	Richness Ratio	EPT Index	EPT Ratio	EPT/C	EPT/C Ratio	Community Loss[2]	HBI[1]	HBI Ratio	Tollerance CTQa Invert.	Tollerance CTQp Phys/Chem	BCI[3] Value Criteria	Shredders /Total	Shredders Ratio
Calculation			None	Site Value/Reference		Site Value/Reference		Site Value/Reference		None	Reference/Site Value				None	Site Value/Reference	
N. Duck R. Reference	WQ0217	Best Score		29	Ratio	10	Ratio	1200%	Ratio		4.48	Ratio	92	60			
Data Base Reference																14%	Ratio
Value Obtained			Value							Value					Value		
Boyne R.	WQ0029	9-20-95	28%	23	79%	1	10%	27%	2.3%	2.9	7.46	59.8%	105	60	57	14%	100%
Boyne R.	WQ0029	9-9-96	24%	30	103%	2	20%	15%	1.3%	1.9	8.04	55.5%	105	99	95	27%	193%
Boyne R.	WQ0029	8-22-97	22%	42	145%	5	50%	57%	4.8%	1.2	6.62	67.4%	100	60	60	7%	50%
Boyne R.	WQ0029	9-4-98	16%	26	90%	2	20%	35%	2.9%	2.3	7.23	61.7%	95	60	63	15%	107%
Brokenhead R.	WQ0038	9-26-95	67%	27	93%	6	60%	169%	15.8%	2.2	7.70	57.9%	102	60	59	3%	21%
Brokenhead R.	WQ0038	9-16-96	64%	29	100%	5	50%	563%	46.9%	2.2	7.42	60.1%	100	60	60	1%	7%
Brokenhead R.	WQ0038	8-20-97	72%	40	138%	7	70%	600%	50.0%	1.4	7.68	58.1%	102	60	59	1%	7%
Brokenhead R.	WQ0038	9-3-98	44%	41	141%	8	80%	1407%	117.3%	1.4	6.74	66.1%	83	60	73	1%	7%
La Salle R.	WQ0068	9-19-95	33%	18	62%	2	20%	30%	2.5%	4.0	7.77	57.4%	99	60	60	10%	71%
La Salle R.	WQ0068	9-17-96	37%	16	55%	2	20%	267%	22.3%	4.3	7.49	59.5%	103	99	96	4%	29%
La Salle R.	WQ0068	8-19-97	44%	19	66%	2	20%	4%	0.3%	4.0	8.36	53.3%	102	90	88	28%	200%
La Salle R.	WQ0068	8-19-98	59%	10	34%	1	10%	4%	0.3%	7.7	9.70	46.0%	106	60	56	61%	436%
L. Saskatchewan R.	WQ0105	9-21-95	83%	39	134%	12	120%	52%	4.3%	1.3	7.85	56.8%	106	89	84	2%	14%
L. Saskatchewan R.	WQ0105	9-18-96	79%	66	228%	16	160%	1326%	110.5%	0.7	7.76	57.5%	103	97	94	0.3%	2%
L. Saskatchewan R.	WQ0105	9-9-97	91%	41	141%	7	70%	254%	21.2%	1.5	7.86	56.7%	106	55	52	0.3%	2%
L. Saskatchewan R.	WQ0105	9-16-98	66%	43	148%	11	110%	675%	56.3%	1.3	7.92	56.3%	99	86	87	2.0%	14%
Rat R.	WQ0131	9-20-95	35%	41	141%	12	120%	1297%	108.1%	1.4	5.20	85.8%	76	60	79	3%	21%
Rat R.	WQ0131	9-9-96	22%	31	107%	7	70%	1131%	94.3%	1.9	5.37	83.1%	88	90	102	2%	14%
Rat R.	WQ0131	9-10-97	53%	32	110%	9	90%	1097%	91.4%	1.8	3.80	117.2%	92	90	98	2%	14%
Rat R.	WQ0131	8-20-98	24%	36	124%	10	100%	615%	51.3%	1.5	6.16	72.4%	93	60	65	5%	36%
Roseau R. Dam	WQ0153	9-20-95	34%	19	66%	9	90%	1017%	84.8%	3.7	3.96	112.6%	81	60	74	1%	7%
Roseau R. Dam	WQ0153	9-9-96	41%	12	41%	9	90%	5000%	416.7%	6.3	3.48	128.1%	57	60	105	20%	143%
Roseau R. Dam	WQ0153	8-22-97	24%	24	83%	11	110%	986%	82.2%	2.6	3.98	112.1%	66	60	91	27%	193%
Roseau R. Dam	WQ0153	9-4-98	17%	26	90%	11	110%	393%	32.8%	2.3	5.64	79.1%	79	60	76	17%	121%
Seine R.	WQ0166	9-19-95	27%	36	124%	8	80%	144%	12.0%	1.6	7.01	63.6%	102	60	59	8%	57%
Seine R.	WQ0166	9-17-96	49%	31	107%	3	30%	6%	0.5%	1.9	8.49	52.5%	105	60	57	54%	386%
Seine R.	WQ0166	8-19-97	34%	24	83%	2	20%	11%	0.9%	2.6	6.87	64.9%	97	60	62	1%	7%
Seine R.	WQ0166	8-18-98	78%	32	110%	4	40%	81%	6.8%	1.9	7.83	57.0%	107	60	56	1%	7%
Whitemud R.	WQ0197	9-21-95	40%	36	124%	12	120%	284%	23.7%	1.6	5.46	81.7%	63	60	96	54%	386%
Whitemud R.	WQ0197	9-19-96	36%	30	103%	11	110%	370%	30.8%	2.1	5.81	76.7%	84	90	108	11%	79%
Whitemud R.	WQ0197	9-9-97	22%	56	193%	16	160%	403%	33.6%	0.8	5.43	82.1%	79	60	76	3%	21%
Whitemud R.	WQ0197	9-16-98	12%	37	128%	8	80%	147%	12.3%	1.5	7.18	62.1%	95	60	63	8%	57%
							0%										
N. Duck R.	WQ0217	9-26-95	67%	29	100%	9	90%	1200%	100.0%	2.2	4.52	98.7%	103	60	58	3%	21%
N. Duck R.	WQ0217	8-27-96	65%	15	52%	6	60%	325%	27.1%	4.7	5.10	87.4%	98	60	61	3%	21%
N. Duck R.	WQ0217	8-26-97	55%	29	100%	10	100%	467%	38.9%	2.1	4.46	100.0%	92	60	65	3%	21%
N. Duck R.	WQ0217	9-22-98	83%	24	83%	9	90%	83%	6.9%	2.6	6.95	64.1%	108	60	57	5%	36%

Appendix 4. Calculations used for biological scoring using data from Table 2 and metric evaluation from Figure 2 (continued).

Stream	Site	Date	Dominant Taxa (%)	Taxa Richness Site Value/Reference	Richness Ratio	EPT Index	EPT Ratio	EPT/C	EPT/C Ratio	Community Loss[2]	HBI[1]	HBI Ratio	Tollerance CTQa Invert.	Tollerance CTQp Phys/Chem	BCI[3] Value Criteria	Shredders /Total	Shredders Ratio
Sclater R.	WQ0220	9-26-95	32%	25	86%	2	20%	7%	0.6%	2.6	7.76	57.5%	95	60	63	6%	43%
Sclater R.	WQ0220	8-27-96	29%	32	110%	10	100%	675%	56.3%	1.9	6.90	64.7%	87	60	69	9%	64%
Sclater R.	WQ0220	8-26-97	24%	37	128%	8	80%	663%	55.3%	1.5	7.04	63.4%	84	60	71	3%	21%
Sclater R.	WQ0220	9-22-98	43%	16	55%	0	0%	0%	0.0%	4.5	7.74	57.8%	92	60	65	2%	14%
Fishing R.	WQ0223	9-25-95	31%	31	107%	5	50%	71%	5.9%	1.9	7.78	57.3%	101	60	60	11%	79%
Fishing R.	WQ0223	8-26-96	24%	18	62%	4	40%	500%	41.7%	4.1	7.23	61.7%	99	60	60	7%	50%
Fishing R.	WQ0223	8-25-97	23%	20	69%	9	90%	473%	39.4%	3.4	5.67	78.6%	78	60	77	4%	29%
Fishing R.	WQ0223	9-24-98	36%	17	59%	10	100%	4967%	413.9%	4.1	4.49	99.3%	58	60	104	14%	100%
Mossy R.	WQ0226	9-25-95	39%	31	107%	10	100%	1500%	125.0%	1.8	6.10	73.1%	84	60	71	3%	21%
Mossy R.*	WQ0226	8-26-96	22%	35	121%	8	80%	62%	5.2%	1.7	6.82	65.3%	91	60	66	4%	29%
Mossy R.	WQ0226	8-25-97	26%	34	117%	7	70%	340%	28.3%	1.6	6.41	69.6%	81	60	74	2%	14%
Mossy R.	WQ0226	9-23-98	23%	34	117%	11	110%	465%	38.8%	1.6	5.87	76.0%	77	60	77	9%	64%
Ochre R.	WQ0227	9-25-95	48%	17	59%	9	90%	1325%	110.4%	4.2	6.05	73.7%	69	60	87	8%	57%
Ochre R.	WQ0227	8-26-96	51%	21	72%	11	110%	988%	82.3%	3.4	3.36	132.5%	59	60	102	0%	0%
Ochre R.	WQ0227	8-27-97	46%	28	97%	7	70%	173%	14.4%	2.1	5.61	79.4%	94	60	64	9%	64%
Ochre R.	WQ0227	9-21-98	26%	31	107%	17	170%	960%	80.0%	1.9	5.38	83.0%	80	60	75	11%	79%
Pine R.	WQ0233	9-26-95	19%	39	134%	12	120%	98%	8.2%	1.5	7.36	60.6%	96	60	62	2%	14%
Pine R.	WQ0233	8-27-96	21%	28	97%	4	40%	20%	1.7%	2.3	7.62	58.6%	96	60	63	25%	179%
Pine R.	WQ0233	8-26-97	21%	42	145%	4	40%	111%	9.3%	1.3	7.51	59.4%	95	60	63	7%	50%
Pine R.	WQ0233	9-23-98	18%	51	176%	6	60%	58%	4.8%	0.9	7.73	57.7%	94	60	64	1%	7%
Swan R.	WQ0244	9-26-95	50%	10	34%	5	50%	Infinate	Infinate	7.5	4.38	101.9%	78	60	77	5%	36%
Swan R.	WQ0244	8-27-96	22%	14	48%	6	60%	450%	37.5%	5.0	5.87	76.0%	76	60	79	2%	14%
Swan R.	WQ0244	8-26-97	18%	23	79%	13	130%	345%	28.8%	2.7	4.08	109.3%	69	60	87	1%	7%
Swan R.	WQ0244	9-22-98	32%	22	76%	9	90%	363%	30.3%	3.0	4.98	89.6%	66	60	91	25%	179%
Turtle R. @ Ste. Rose	WQ0245	9-25-95	51%	29	100%	5	50%	261%	21.8%	2.1	7.19	62.0%	98	60	61	1%	7%
Turtle R. @ Ste. Rose	WQ0245	8-26-96	78%	28	97%	9	90%	167%	13.9%	2.2	7.75	57.6%	105	60	57	1%	7%
Turtle R. @ Ste. Rose	WQ0245	8-27-97	64%	28	97%	4	40%	73%	6.1%	2.0	7.78	57.3%	105	60	57	3%	21%
Turtle R. @ Ste. Rose	WQ0245	9-21-98	51%	35	121%	7	70%	292%	24.3%	1.5	6.80	65.6%	104	60	58	2%	14%
Valley R.	WQ0250	9-25-95	19%	33	114%	11	110%	201%	16.8%	1.6	5.18	86.0%	87	60	69	22%	157%
Valley R.	WQ0250	8-26-96	32%	20	69%	6	60%	120%	10.8%	3.5	7.17	62.2%	95	60	63	8%	57%
Valley R.	WQ0250	8-25-97	18%	28	97%	12	120%	376%	31.3%	2.2	5.06	88.1%	76	60	79	2%	14%
Valley R.	WQ0250	9-21-98	42%	13	45%	6	60%	871%	72.6%	5.6	3.65	122.2%	43	60	139	42%	300%
Vermilion R.	WQ0252	9-25-95	35%	19	66%	7	70%	3825%	318.8%	3.5	4.44	100.5%	48	60	124	37%	264%
Vermilion R.	WQ0252	8-28-96	49%	25	86%	7	70%	32%	2.7%	2.5	7.76	57.5%	102	60	59	0%	0%
Vermilion R.	WQ0252	8-25-97	50%	25	86%	9	90%	1355%	112.9%	2.6	6.51	68.5%	80	60	75	2%	14%
Vermilion R.	WQ0252	9-24-98	37%	27	93%	9	90%	500%	41.7%	2.2	6.74	66.1%	92	60	65	2%	14%
Edwards Cr.	WQ0253	9-25-95	20%	42	145%	14	140%	156%	13.0%	1.3	5.78	77.1%	93	60	65	10%	71%
Edwards Cr.	WQ0253	8-28-96	41%	49	169%	16	160%	42%	3.5%	1.0	6.72	66.4%	95	60	63	4%	29%
Edwards Cr.	WQ0253	8-27-97	38%	40	138%	13	130%	958%	79.8%	1.3	5.26	84.8%	77	60	78	3%	21%
Edwards Cr.	WQ0253	9-24-98	39%	13	45%	8	80%	39%	3.3%	5.5	4.55	98.1%	61	60	98	8%	57%

Appendix 4. Calculations used for biological scoring using data from Table 2 and metric evaluation from Figure 2 (continued).

Stream	Site	Date	Dominant Taxa (%)	Taxa Richness Site Value/Reference	Richness Ratio	EPT Index	EPT Ratio	EPT/C	EPT/C Ratio	Community Loss[2]	HBI[1]	HBI Ratio	Tollerance CTQa Invert.	Tollerance CTQp Phys/Chem	BCI[2] Value Criteria	Shredders /Total	Shredders Ratio
Wilson R.	WQ0255	9-25-95	43%	18	62%	5	50%	3680%	306.7%	3.9	4.73	94.2%	63	90	143	45%	321%
Wilson R.	WQ0255	8-28-96	39%	26	90%	7	70%	245%	20.4%	2.4	6.55	68.1%	81	90	112	15%	107%
Wilson R.	WQ0255	8-25-97	55%	20	69%	6	60%	49%	4.1%	3.3	6.36	70.1%	103	60	58	18%	129%
Wilson R.	WQ0255	9-21-98	51%	18	62%	10	100%	9100%	758.3%	3.7	4.85	92.0%	63	60	95	3%	21%
Woody R.	WQ0259	9-26-95	20%	26	90%	9	90%	233%	19.4%	2.4	6.23	71.6%	93	60	64	2%	14%
Woody R.	WQ0259	8-27-96	40%	10	34%	1	10%	7%	0.6%	7.5	6.98	63.9%	101	60	59	2%	14%
Woody R.	WQ0259	8-26-97	60%	45	155%	15	150%	747%	62.3%	1.1	5.58	80.0%	54	60	110	8%	57%
Woody R.	WQ0259	9-22-98	49%	44	152%	17	170%	54%	4.5%	1.1	7.36	60.6%	86	60	70	63%	450%
Souris R.	WQ0350	9-21-95	55%	40	138%	13	130%	167%	13.9%	1.3	6.86	65.0%	100	108	108	11%	79%
Souris R.	WQ0350	9-18-96	63%	25	86%	7	70%	161%	13.4%	2.5	7.09	62.9%	99	108	109	4%	29%
Souris R.	WQ0350	9-8-97	19%	40	138%	13	130%	323%	26.9%	1.3	5.54	80.5%	82	99	120	7%	50%
Souris R.	WQ0350	9-15-98	46%	40	138%	10	100%	133%	11.1%	1.3	6.45	69.1%	92	99	107	18%	129%
Marsh R.	WQ0365	9-20-95	32%	47	162%	5	50%	22%	1.8%	1.4	8.01	55.7%	100	60	60	30%	214%
Marsh R.	WQ0365	9-9-96	95%	32	110%	6	60%	200%	16.7%	2.1	7.97	55.9%	107	90	84	1%	7%
Marsh R.	WQ0365	9-10-97	58%	24	83%	1	10%	12225%	1018.8%	2.7	7.77	57.4%	100	60	60	1%	7%
Marsh R.	WQ0365	8-20-98	61%	18	62%	2	20%	513%	42.8%	3.9	7.24	61.6%	82	60	73	5%	36%
Cypress R.	WQ0398	9-21-95	56%	37	128%	8	80%	684%	57.0%	1.5	7.11	62.7%	83	108	130	9%	64%
Cypress R.	WQ0398	9-18-96	28%	28	97%	5	50%	107%	8.9%	2.1	7.27	61.3%	89	99	111	28%	200%
Cypress R.	WQ0398	9-8-97	49%	41	141%	11	110%	633%	52.8%	1.3	5.86	76.1%	78	90	115	2%	14%
Cypress R.	WQ0398	9-15-98	41%	42	145%	10	100%	49%	4.1%	1.1	7.74	57.6%	95	90	94	43%	307%
Waterhen R.**	WQ0561	9-25-95	87%	32	110%	13	130%	125%	10.4%	2.0	7.86	56.8%	106	60	57	2%	14%
Waterhen R.	WQ0561	8-26-96	23%	22	76%	9	90%	658%	54.8%	3.2	6.44	69.3%	91	60	66	12%	86%
Waterhen R.	WQ0561	8-25-97	32%	37	128%	15	150%	186%	15.5%	1.7	6.31	70.6%	97	60	62	5%	36%
Waterhen R.	WQ0561	9-23-98	58%	31	107%	12	120%	4257%	354.8%	2.0	6.99	63.8%	96	60	63	2%	14%
Cooks Creek	WQ0643	9-16-96	40%	29	100%	6	60%	158%	13.2%	2.1	7.53	59.2%	102	90	89	9%	64%
Cooks Creek	WQ0643	8-20-97	24%	37	128%	5	50%	273%	22.8%	1.5	6.60	67.5%	88	90	102	8%	57%
Cooks Creek	WQ0643	9-3-98	14%	33	114%	6	60%	200%	16.7%	1.8	6.98	63.9%	99	90	91	9%	64%
Cooks Creek	WQ0644	9-16-96	72%	27	93%	4	40%	1823%	151.9%	2.4	6.96	64.1%	79	60	76	1%	7%
Cooks Creek	WQ0644	8-20-97	33%	19	66%	3	30%	8%	0.7%	3.5	7.02	63.5%	108	60	56	18%	129%
Pipestone Cr. Diversion	WQ1242	10-1-96	77%	26	90%	4	40%	1800%	150.0%	2.7	6.24	71.4%	108	90	84	77%	550%
Pipestone Cr. Diversion	WQ1242	9-8-97	74%	22	76%	2	20%	Infinate	Infinate	3.0	7.56	59.0%	108	90	84	21%	150%
Pipestone Cr. Diversion	WQ1242	9-15-98	68%	35	121%	2	20%	25%	2.1%	1.9	7.48	59.6%	108	90	84	24%	171%

Appendix 5. Canadian water quality index (CWQI), water quality variables and objectives or guidelines (Williamson 2000, Williamson 1988) used to calculate CWQI values (CCME 2000).

Variables	Units	Objective* Value	Objective* Use
Fecal Coliform MF	Bacteria/100mL	200	Recreation
Ph	Ph Units	6.5-9.0	Aquatic Life
Specific Conductivity	uS/cm	1000	Greenhouse Irrigation
Total Suspended Solids	mg/L	25 (mid range)	Aquatic Life
Dissolved Oxygen	mg/L	5 (mid range)	Aquatic Life
Total or Extractable Cadmium*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total or Extractable Copper*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total Arsenic	mg/L	0.025	Drinking Water, Health
Total or Extractable Lead*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Dissolved Aluminum	mg/L	0.1 for pH >6.5	Aquatic Life
Total or Extractable Nickel*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total or Extractable Zinc*	mg/L	Calculation based on Hardness (7Q10)	Aquatic Life
Total or Extractable Manganese	mg/L	0.05	Drinking Water, Aesthetic
Total or Extractable Iron	mg/L	0.3	Drinking Water, Aesthetic
Total Ammonia as N	mg/L	Calculation based pH	Aquatic Life
Soluble or Dissolved Nitrate-Nitrite	mg/L	10	Drinking Water, Health
Total Phosphorus	mg/L	0.050	Nuisance Plant Growth
Dicamba	ug/L	0.006 where detectable	Irrigation
Bromoxynil	ug/L	0.33	Irrigation
Simazine	ug/L	0.5	Irrigation
2,4 D	ug/L	4	Aquatic Life
Lindane	ug/L	0.08	Aquatic Life
Atrazine	ug/L	1.8	Aquatic Life
MCPA	ug/L	0.025 where detectable	Irrigation
Trifluralin	ug/L	0.2	Aquatic Life

* Calculation based on dissolved metals and may slightly over estimate excursions.

CWQI (CCME 2000) Category ranges: 95-100 Excellent; 80-94 Good; 60-79 Fair; 45-59 Marginal; 0-44 Poor

$CWQI = 100-(((F_1^2+F_2^2+F_3^2)^{1/2})/1.732)$

Scope F_1 = ((Number of variables with an objective not met)/(Total number of variables))x100

Frequency F_2 = ((Number of samples with an objective not met)/(Total number of samples))x100

Amplitude $F_3 = ((nse/(0.01nse + 0.01))$

Where *nse* is the normalized sum of test excursions:

$nse = (\text{Sum of excursions}_i)/(\text{Total number of tests})$

Where test values must not exceed the objective:

$\text{excursion}_i = (\text{Concentration}_i)/(\text{Objective}_j)$

Where test values must not fall below the objective:

$\text{excursion}_i = (\text{Objective}_j)/(\text{Concentration}_i)$

Where the objective is zero:

$\text{excursion}_i = \text{Concentration}_i$